Intangible Barriers to Trade

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Intangible Barriers to Trade

The Impact of Institutions, Culture, and Distance on Patterns of Trade

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VRIJE UNIVERSITEIT

Intangible Barriers to Trade
The Impact of Institutions, Culture, and Distance on Patterns of Trade

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. T. Sminia,
in het openbaar te verdedigen
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door

Gert-Jan Marie Linders

geboren te Roermond

promotoren:	prof.dr. P. Nijkamp
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Gert-Jan Linders,
’s-Hertogenbosch, December 2005

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A long time ago came a man on a track
(…)
and he put down his load where he thought it was the best
he made a home in the wilderness
(…)
and the other travellers came riding down the track
and they never went further and they never went back
then came the churches then came the schools
then came the lawyers then came the rules
then came the trains and the trucks with their loads
and the dirty old track was the telegraph road

Dire Straits, *Telegraph Road*

Chapter 1

Motivation

1.1 Gains from trade

International trade raises economic efficiency in the trading countries. Nations differ in terms of their relative productivity in different industries. Moreover, they differ in the availability of productive factors, such as specific types of labour (skilled and unskilled, for example) and physical capital goods, which are needed in differing proportions across the various industries. In the absence of international trade, each country would produce some goods relatively expensively and some goods relatively cheaply compared to other countries, depending on which industries it can produce relatively more efficiently in. Trade between countries enables consumers to buy products cheaply from around the world. In this way, trade allows a country to import those goods that it can only make relatively expensively and enables it to export those products that can be produced relatively cheaply domestically. This raises economic efficiency, because each country can concentrate its resources in those industries in which it is relatively more efficient, or (as economists say), in those industries where it has a comparative advantage (see, e.g., Baldwin and Wyplosz, 2004).[1] As a result,

[1] The notion of comparative advantage due to differences in productivity has been introduced by the classical economist David Ricardo in his work 'On the Principles of Political Economy, and Taxation' (1817). Comparative advantage related to differences in relative factor endowments is known as 'Heckscher-Ohlin' comparative advantage, after the two economists who developed the theory.

consumers across the world are better off than in a situation of autarky, in which each country would have to produce all products itself.[2]

The gains from trade are not only based on comparative advantage. The larger market opened up by international trade also generates gains from an increased scale of production, from more intense competition and from the availability of an increased diversity of products to consumers. Perhaps the most obvious advantage of trade is that countries gain access to products that they cannot produce at home. Most notably, this applies to natural resources such as oil and mineral ores, which not many countries are richly endowed with. However, a similar argument extends to the introduction of new product innovations, developed abroad (see Romer, 1994). These products embody 'state-of-the-art' technological developments that yield many benefits to consumers.

The opportunity to exploit scale economies in a larger market has been noted already by Adam Smith in his classical work 'An Inquiry into the Nature and Causes of the Wealth of Nations' (1776). Production at a larger scale involves an increased division of labour, in which workers specialize in a specific part of the production process. This leads to higher productivity and lower production costs. The presence of scale economies also motivated the development of so-called 'new trade theory' (e.g., Krugman, 1979; Helpman and Krugman, 1985). If countries start to trade, scale effects in production imply that each country will specialize in certain industries or specific varieties of products. International trade increases competition between producers, because consumers across the world are spreading their expenditure over a wider variety of goods. As a result, prices are forced downward, as

[2] These gains may not occur immediately upon opening up to trade with the rest of the world. Shifting resources from one sector to another takes time, during which workers may be unemployed and production capital may lay idle. Apart from structural adjustment, groups may loose, because they represent production factors that were relatively scarce before 'liberalization' of trade, but are not relatively scarce anymore after trade has opened up, because the sector in which they had been employed shrinks in response to increased import competition. However, as explained, the nation as a whole gains in terms of output and consumption, because the production factors are allocated across industries more efficiently. Thus, the winners can compensate the losers of trade. This can be achieved by redistributive policy, subsidies for retraining, etc. Moreover, we will see that gains from trade do not exclusively arise from comparative advantages, but also from other factors that benefit all.

producers try to steal away customers from competitors. To survive, firms need to operate at a larger scale to drive down production costs by exploiting scale economies. This forces some firms out of the market, while the remaining firms will produce more than initially, at lower prices. To consumers, this means that they can choose from a wider variety of products and benefit from lower prices. Wider choice increases consumer welfare, because of their 'love of variety' (cf. Dixit and Stiglitz, 1977; Romer, 1994), as do lower prices.

Finally, international trade also generates technology spillovers between countries (e.g., see Coe and Helpman, 1995; Lejour and Nahuis, 2005), and – as already mentioned above – introduces new foreign products (e.g., Romer, 1994). These trade effects contribute to a higher long-run economic growth and increased welfare over time (e.g., Frankel and Romer, 1999; Lewer and Van den Berg, 2003).

1.2 Growth in trade: past and present

Barriers related to physical geography, culture and politics have traditionally obstructed trade between countries. However, the potential benefits of trade have resulted in many examples of trading routes and expansion of civilisations in space, in order to acquire scarce or new products. Since the Industrial Revolution in the late 18th and 19th century, which gave birth to modern (industrial) economies and capitalism, international trade has grown rapidly as compared to world output (see Table 1.1).[3]

The growth in trade was stimulated by advances in transport and communication technologies (such as, the introduction of steamships, railroads, canal systems, telegraph, etc.), and by policy changes toward more openness in many countries. At the end of the 19th century, this led to the first wave of globalization (e.g., Crafts and Venables, 2001). In the first half of the 20th century, though, the Great Depression and both World Wars caused a slowdown in trade, as protectionism revived and countries became more inward looking.

[3] Because world GDP has started growing at a historically unprecedented rate at around the same time, this implies that growth in trade was even more unprecedented, as it outpaced the growth of national economies (see Maddison, 2001).

Since the second half of the 20th century, a renewed acceleration in the growth of world trade has occurred (see Table 1.1).

Table 1.1 World merchandize exports as share of world GDP

Year	Exports/GDP (%)
1820	1.0
1870	4.6
1913	7.9
1929	9.0
1950	5.5
1973	10.5
1998	17.2

Source: Maddison (2001); based on Table F-5 (p. 363).

Growth in world trade has consistently outpaced worldwide growth in GDP over the past decades (e.g., Baier and Bergstrand, 2001). For the European Union (EU), trade with countries in the rest of the world has risen by 730% in real terms over the period 1960-2000, whereas intra-EU trade even rose by 1200% over that period (CPB, 2005, p. 152).

This wave of international integration is related to several factors. First, the post-war period has been characterized by extensive trade liberalization (reducing tariff protection and non-tariff barriers), spurred by multilateral agreements and organizations such as the General Agreement on Tariffs and Trade (GATT) and its successor organization, the World Trade Organization (WTO).[4] Furthermore, additional improvements in transportation technology and infrastructure and the advent of modern Information and Communication Technology (ICT) have contributed substantially as well. Baier and Bergstrand (2001) show that, apart from the growth in GDP, which explains most of the growth in world trade, the reduction in tariffs is mostly responsible for trade growth, followed by declines in transport costs. The effect of ICT-driven reductions in trade costs has not been directly measured in their paper

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[4] The process of multilateral liberalization has co-existed with many initiatives for closer regional economic integration, which has resulted in many preferential trade agreements, free trade areas (such as the North American Free Trade Agreement, NAFTA) and customs unions (like the EU, that has progressed further into a single market – this implies free movement of labour, capital and services as well). For an overview, see Frankel (1997).

and could be captured by either the transport costs term or in the coefficient on GDP growth. Trade growth in recent decades has also been related to increased outsourcing of production processes (vertical specialization, or fragmentation of production) across borders, a change in the organization of production that is linked to reductions in transport costs, communication costs and tariffs (e.g., Yi, 2003).

The rapid growth in world trade has resulted in substantial efficiency gains in those countries that have been able to participate in this development. To express this in monetary terms, consider Hufbauer and Grieco (2005), who state that an average American household enjoys annual benefits worth about US$10,000 from 'shrinking distances' (due to ICT and advances in shipping) and declining policy barriers to trade and investment over the past decades. Similarly, Badinger (2005) estimates that the EU-15 countries would have had 20% lower incomes per capita, on average, in the absence of post-war international economic integration (cit. in CPB, 2005).

Despite the fast pace of growth in world trade during the past decades, Table 1.1 still suggests that trade remains surprisingly low, compared to world GDP. When confronting the theoretical expectations with actually observed trade patterns, it becomes clear that countries trade far less than would be justified by the potential scale effects to be exploited and by differences in resource endowments and technology (Trefler, 1995; Loungani et al., 2002). On the basis of an empirical analysis of trade patterns, Eaton and Kortum (2002) argue that trade would be five times as large as presently observed volumes, if trade were frictionless. This 'mystery of missing trade' (cf. Trefler, 1995) illustrates that trade barriers are persistent and have remained important determinants of the volume and patterns of trade across countries.[5] For one, there still is a lot of work to be done within WTO negotiations on further liberalization of worldwide trade. However, trade policy is not the only determinant of the

[5] As a result, countries that are skilled in reducing the transaction costs of international trade can gain a competitive edge in trading, as a transport hub or, in general, as a country of traders (see, e.g., WRR, 2003).

resistance to international trade. The next section discusses how barriers to trade affect trade patterns, and identifies two types of trade barriers that can be distinguished.

1.3 Tangible versus intangible barriers to trade

Given the large potential benefits of trade, the persistent resistance to international trade indicates that trade costs are high as well. To explain trade costs, we have to look at the barriers that lead to these costs. Trade barriers can be defined as obstacles in space or time that impede a smooth, frictionless transaction of information or products (cf. Nijkamp et al., 1990, cited in Van Houtum, 1998, p. 20).[6]

Geographic distance is the most obvious candidate to explain the resistance to trade. Because of distance, transport costs have to be incurred to deliver traded goods from the exporting country to the importer. Despite technological improvements in transport and ICT, we observe an almost 'immutable effect of physical distance' on trade (cf. Poot, 2004). Geographic distance between countries strongly affects trade, and the influence of distance does not appear to have diminished over time (e.g., Berthelon and Freund, 2004).

As an illustration of the importance of distance barriers to trade, consider how distance affects the typical export pattern for The Netherlands. For a set of selected countries, Figure 1.1 plots Dutch bilateral exports (corrected for the destination-country level of GDP)[7] against the geographic distance to each country. The results clearly show that trade falls sharply with distance, after correcting for country size, and illustrate the importance of physical distance for explaining the observed intensity of bilateral trade between countries. This brings us to the conclusion that nations remain stubbornly apart in economic terms (cf. Wei, 1996; Loungani et al., 2002).

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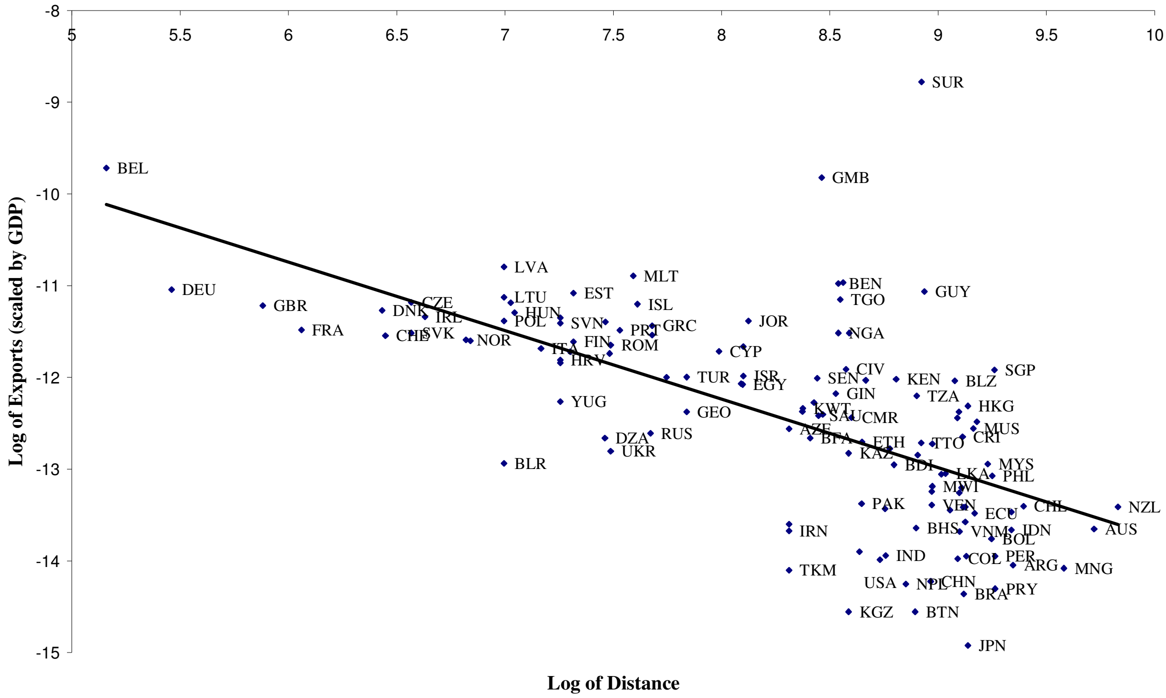
[6] We slightly amend the definition by Nijkamp et al., who focus on barriers, other than the normal average distance friction in spatial interaction (Van Houtum, 1998). We intend to view physical distance *as such* as a barrier to trade, including its implications in terms of the need to transport in order to conduct exchange of goods.

[7] We scale bilateral trade by the GDP of the importing country, because the potential for trade between The Netherlands and a bigger foreign economy is higher.

Figure 1.1 The Netherlands: bilateral exports and geographic distance



Note: The country labels are explained in the list of countries in the Data Appendix.

Apart from geographic distance, there are more factors that drive countries apart in international trade, and raise ‘economic distance’ between them (Ghemawat, 2001). The multidimensional concept of economic distance incorporates all barriers to trade that raise the effective distance between countries and impose trade costs on bilateral trade. Examples of these barriers to trade are tariff barriers, incompleteness of information on foreign markets, differences in the institutional environment and cultural differences between countries.

Two types of barriers to trade can be distinguished. First, trade is obstructed by *tangible barriers*. These barriers are directly observable in terms of the effect on the costs or quantity of trade. Examples are transport barriers, trade policy barriers and currency exchange barriers. These barriers lead to transport costs, tariff duties, quota’s, currency conversion costs and risk premia on exchange rates. Second, we can identify *intangible barriers to trade*, which cannot be observed directly in terms of a monetary or quantitative restriction. Oftentimes, physical distance is interpreted as partly an intangible barrier to trade (see Frankel, 1997). In fact, distance is related to various intangible trade barriers and generates much more than transport costs; it also increases the costs of face-to-face communication, interaction and coordination costs and other information costs. In general, intangible barriers to trade include incomplete information barriers, cultural barriers and institutional barriers (also see Poot, 2004 and Bröcker and Rohweder, 1990).[8]

Both tangible and intangible barriers to trade are important for understanding the variation in trade patterns. However, as noted by Anderson (1999), the traditionally considered tangible trade barriers, such as transport barriers and tariffs, are not sufficient to explain the resistance to trade, especially given the fall in the costs associated with transport, communication and tariff protection. Moreover, intangible barriers to trade, such as those generated by cross-country variation in institutional quality, are important because they are ‘likely to affect the amount of trade generated by trade liberalization’ as well, ‘with implicit consequences for the welfare and growth effects of trade liberalization’ (WTO, 2004, p. 176).

Recently, Anderson and Van Wincoop (2004) summarized the empirical evidence on the effect of trade barriers by indirectly generating quantitative estimates of average trade costs from the empirical results. They found an average 44% mark-up on production costs of border-related trade barriers (excluding transport costs) for a typical developed country, of which only a 5% mark-up is due to average tariffs. Deardorff (2004) thus argues that international trade patterns substantially depend on mostly unobservable trade costs, related to intangible barriers to trade. Furthermore, Obstfeld and Rogoff (2000) highlight the possible role of these unobserved trade costs in sorting out some of the apparent puzzles in international economics, such as the ‘mystery of missing trade’ referred to earlier. Hence, closer inquiry into intangible barriers to trade is needed.

[8] Institutional barriers are identified as intangible barriers to trade. Although in principle some of the costs related to institutions are observable (e.g., legal costs), most of the transaction costs are not directly observable on the market (contracting costs, monitoring costs, regulatory costs, expropriation risks and other uncertainties, and adjustment costs related to differences in the [quality of the] institutional setting).

1.4 Research questions and setup of the thesis

This thesis aims to contribute to the understanding of the determinants of variation in trade patterns. As argued before, the observed patterns of trade reflect the importance of economic distance between countries. Economic distance between countries represents all barriers that increase the resistance to bilateral trade. The economic distance between countries has traditionally been associated with physical distance (raising transport costs) and with import protection (leading to import tariffs and quantitative restrictions on trade). The effect of physical distance on trade has received much attention in the literature on bilateral trade. Improvements in transportation and communication technology have reduced the costs to interaction and trade generated by the physical distance barrier. Still, the relevance of physical distance in conditioning bilateral trade shows that it remains an important barrier to trade. Both the size of the decay of trade over geographic distance and its development over time are subjects of interest in this respect. Given the variation in distance-decay estimates across the literature, a meta-analytic approach is chosen to investigate these issues. Thus, the first research question in the thesis asks,

1. What explains the variation across the literature in the effect of physical distance on bilateral trade and has the effect decreased over time as a consequence of falling costs of transport and communication?

The persistence of the distance effect in trade suggests that physical distance is also associated with intangible barriers between countries, related to information incompleteness and cultural unfamiliarity (e.g., Grossman, 1998). This illustrates the importance of intangible barriers to trade for understanding the underlying mechanisms that explain variation in trade patterns. The purpose of the thesis is to assess the relevance and importance of these barriers, in terms of their effect on trade. This leads to the second research question investigated in this thesis.

2. What are the relevant intangible dimensions of economic distance between countries that affect the intensity of trade?

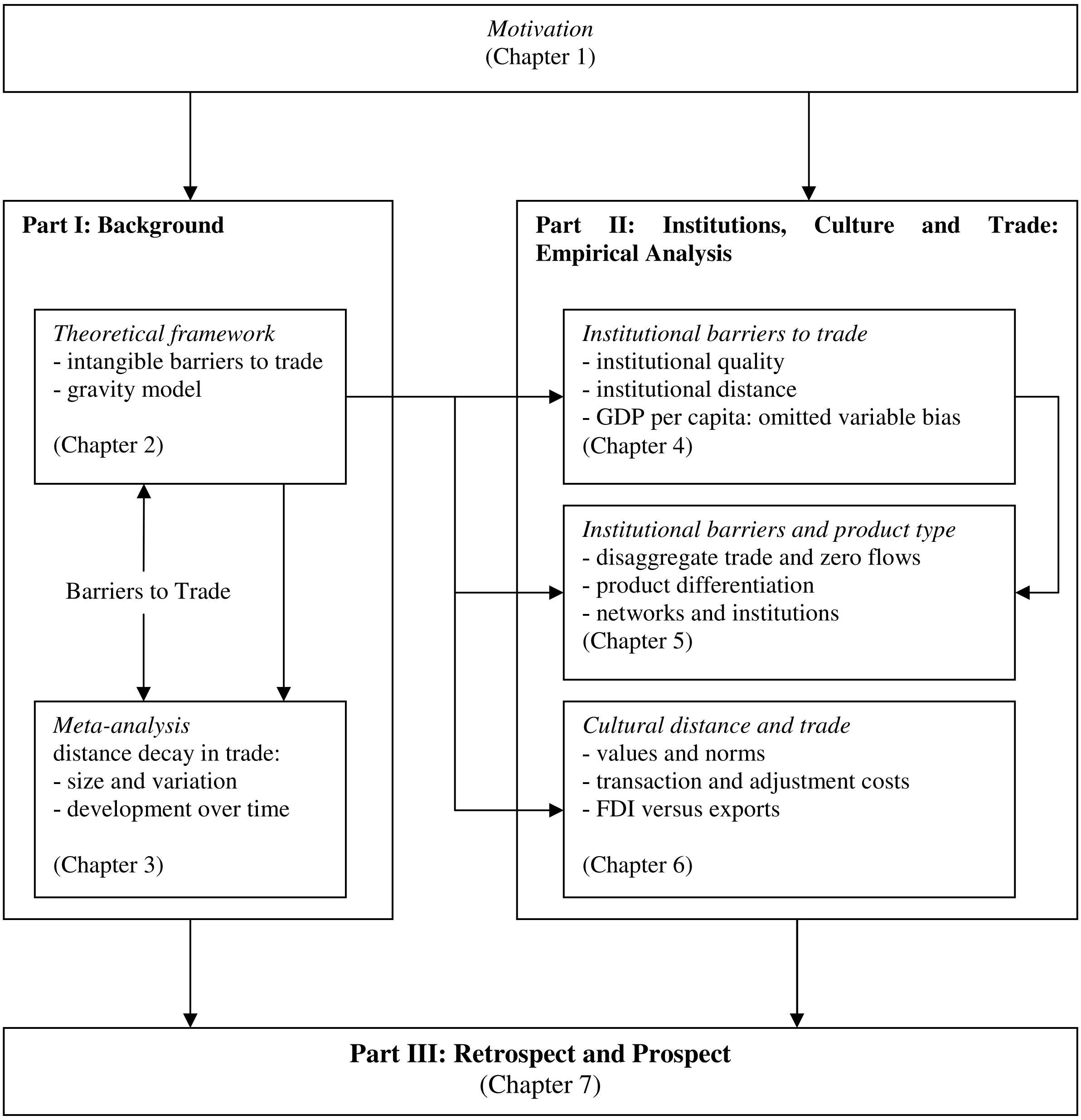
Moreover, the relevance and impact of intangible barriers may vary at a more disaggregate level, depending on the type of product traded. This motivates the third research question.

3. Does the importance of intangible barriers to trade at a more disaggregate level depend on market conditions, in particular the degree of product differentiation?

Figure 1.2 depicts the organization of the thesis, which is divided in three parts. Part I presents the background for the analysis of intangible barriers to trade. Part II consists of the primary empirical analysis of the intangible barriers emphasized in this thesis, viz. institutional and cultural barriers to trade. Part III concludes, looking back at the findings and considering their implications and possibilities for further research.

In Part I (Chapters 2 and 3), we provide the conceptual and theoretical framework for the empirical analysis in Part II and discuss the relevance of intangible barriers for understanding the prominent effect of geographic distance on trade patterns. In Chapter 2, the intangible barriers to trade that add to economic distance are identified and discussed, and the gravity model, used for the analysis of bilateral trade, is introduced. In theoretical respect, Chapter 2 contributes to the understanding of economic distance by considering the relation between the institutional environment and international trade. The effect on trade of differences in cultural values and codes of conduct is explicitly addressed as well (separately from the commonly considered aspect of cultural familiarity, such as common language and colonial history). In other words, Chapter 2 investigates the intangible trade barriers that are proposed to answer the second research question. Chapter 3 focuses on the size and development over time of the geographic-distance effect on trade.

Figure 1.2 Outline of the thesis



The application of meta-analysis methodologically contributes to the debate on the high and persistent importance of geographic distance for bilateral trade. The analysis enables us to infer statistical generalizations from the existing literature to provide insight in the causes of variation in estimated distance decay across the literature and in the size and development of distance-related trade barriers. Thus, Chapter 3 serves to answer the first research question introduced above.

Part II (Chapters 4 to 6) contains the empirical analysis of the relation between institutional and cultural barriers to trade and patterns of bilateral trade, using the gravity model. The questions that guide the analysis in Part II serve as an empirical operationalization for answering the research questions 2 and 3. The significance of the barriers, in terms of their effect on bilateral trade and contribution to the explanation of the variation in trade flows across countries, is addressed. More specifically, the investigations in Chapter 4 focus on the impact of institutional quality and institutional distance barriers on aggregate bilateral trade. The contribution of Chapter 5 is of a theoretical as well as empirical nature. The chapter deals with the relation between institutional barriers and trade at a disaggregate level, classified by product type, and also pays attention to the occurrence of zero-valued bilateral trade flows. Chapter 6 investigates the effect of cultural distance, in terms of values and work-related norms, on bilateral trade. Moreover, the chapter presents a further discussion on the contribution of various trade barriers to the explanation of the variation in trade flows. For a more elaborate discussion on the content of Chapter 3 and the empirical chapters in Part II – Chapters 4 to 6 –, the reader is referred to the next chapter, in which we first develop the conceptual framework in more detail.

Part I

Background

Chapter 2

Barriers to Trade and the Gravity Model[1]

2.1 Introduction

Trade patterns to a considerable degree depend on intangible barriers to trade (Obstfeld and Rogoff, 2000; Deardorff, 2004), which are related to incomplete information, cultural differences and institutional differences across countries. These barriers appear to be very large even between adjacent, relatively similar countries. The existence of national borders *as such* seriously reduces trade, as shown by the decrease in interregional trade flows once they cross country borders (e.g., Bröcker, 1984; McCallum, 1995; Feenstra, 2004). Furthermore, the size of distance decay in trade is too large to be attributed exclusively to the effect of transport costs (Wonnacott, 1998). Illustratively, recent evidence shows that geographic distance reduces trade in financial assets to an extent that is at least comparable to merchandize trade, even though transport costs are not an issue in the exchange of financial claims (e.g., Portes et al., 2001). In this respect, geographic distance is a proxy of various intangible barriers that are related to incomplete information and cultural unfamiliarity (see, e.g., Frankel, 1997; Loungani et al., 2002). The distance effect in trade hence provides an indication for the importance of intangible trade barriers.

[1] This chapter is partly based on De Groot et al. (2004); Linders et al. (2005a); and Linders et al. (2005c).

In this chapter, we explore the dimensions of intangible barriers to trade more closely, focusing on institutional and cultural variation across countries. Because of incomplete and asymmetric information, cultural differences and variation in the institutional environment, it is more costly to engage in successful cooperative behaviour across national boundaries. In a setting of imperfectly competitive markets, imperfect insight, uncertainty and asset specificity, in which many transactions are conducted over time and repeated with some frequency, cooperative behaviour matters. Granovetter (1985) argues that under such circumstances the discipline of competition is insufficient to safeguard mutual interests in transactions and prevent opportunistic behaviour. As international trade involves multiple legal and political systems, property rights and commitment to contracts are more difficult to secure (Rodrik, 2000; Greif, 2000). This raises the costs of writing contracts, enforcing the agreements and self-insuring against malfeasance in trade (Anderson and Van Wincoop, 2004). As a result, the quality of the institutional environment protecting property rights and contracts matters for trade. Trusting and trustworthy behaviour are social assets that improve informal enforcement of cooperative behaviour, increase the security of trade and reduce transaction costs. Cultural familiarity between countries reduces information asymmetries and increases bilateral trust. Cultural similarity leads to similar informal norms and procedures of business, increases bilateral trust and reduces adjustment costs in exchange. The following two sections further discuss these dimensions of barriers to trade.

2.2 Institutions and trade

The unobserved barriers to trade are often related to incomplete or asymmetric information and uncertainty in exchange. North (1990) argues that, because of imperfect insight and incomplete information, people form institutions. He defines institutions as “humanly devised constraints that shape human interaction”. These rules of the game are intended to reduce the uncertainty in exchange, and lower transaction costs. The impact of institutions on transaction costs has received a lot of attention in the literature on economic growth and development (e.g., Barro, 1991; Knack and Keefer, 1995; Sala-i-Martin, 1997; Olson, 1996; Hall and

Jones, 1999). This literature builds on the notion that poor governance entails negative externalities for private transactions, and consequently raises transaction costs, with negative effects on growth and development. Recent research has further contributed to the understanding of the relation between institutions and growth, by distinguishing two types of institutions, property rights institutions and contracting institutions (e.g., Acemoglu and Johnson, 2003). Apparently, property rights institutions, that determine the security of property from expropriation by the state, are particularly important in explaining economic development over time.

The institutional environment is also relevant for international trade (see, e.g., Rodrik, 2000; Wei, 2000a; Dixit, 2004). Because international transactions involve multiple governance systems, the effectiveness of domestic institutions in securing property rights and contract enforceability in exchange is an important determinant of trade costs. The quality of institutions affects expropriation risks, corruption, the enforceability of private contracts and the security of trade in general (see, e.g., Rodrik, 2000).[2] Furthermore, formal rules affect informal norms of behaviour and inter-personal trust, which influence the mores and conventions of doing business. These, in turn, may affect risk perceptions in international transactions. As an illustration, consider that corruption can sometimes reflect a reaction to poor quality of the institutional framework (in terms of a heavy burden of red tape, or bureaucratic delay, in conducting transactions).

Compared to the literature on institutions and growth, the impact of institutions on international trade flows has received relatively little attention until recent years. The literature is expanding fast, though. For example, several studies show that corruption levels

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[2] Evidently, the growth and trade lines of research are closely related. Many studies have identified openness to international trade as an important determinant of economic growth (e.g., Frankel and Romer, 1999). Thus, even if institutions are shown to be of less direct importance for economic performance than trade (cf. Dollar and Kraay, 2002), a strong link between the quality of governance and trade reconfirms the importance of good governance for long-run economic performance. See, for example, Frankel and Rose (2002) who use a gravity model approach to argue that the main benefits of a currency union for economic performance are related to its positive effect on trade and openness.

negatively affect the intensity of cross-border transactions (Kaufmann and Wei, 1999; Wei, 2000b; De Jong and Udo, 2005). Thus, the negative effect on trade of corruption, as a manifestation of bad governance, appears to dominate the positive effect of corruption as a 'safety valve' to relieve the pressure of red tape. Several recent empirical studies have included institutional quality indicators as a determinant of trade (e.g., Anderson and Marcouiller, 2002; Koukhartchouk and Maurel, 2003; Redding and Venables, 2003; Jansen and Nordas, 2004 and WTO, 2004), showing that better quality institutions increase openness and bilateral trade.

2.3 Culture, incomplete information and trade

Cultural differences are important intangible barriers to trade, increasing economic distance between traders (Linnemann, 1966; Drysdale and Garnaut, 1982). These differences consist of two aspects: knowledge, or familiarity, between cultures, and differences in norms and values between cultures. People are in general less informed about foreign markets and cultures. Through newspapers, television and direct communication, they are much more informed about domestic developments, especially in terms of the richness of details (Van Houtum, 1998). Furthermore, information and knowledge on distant foreign markets and cultures tend to be less than for nearby societies. Cultural familiarity decreases across geographical distance, which may help explain why less information is collected about distant markets. The causality also runs in the opposite direction, with lack of information reinforcing unfamiliarity with foreign cultures. Familiarity with foreign cultures increases if historical ties exist, e.g., through language and colonial history.

Incomplete information and unfamiliarity with foreign cultures generate "psychic distance" between countries (e.g., Beckerman, 1956; Klaassen et al., 1972; Frankel, 1997). Cultural familiarity between countries reduces psychic distance and lowers trade costs. For example, proximity, common language and pre-existing ties make it easier to share information and knowledge between countries. Many studies have found that bilateral trade increases when countries share a common language or colonial past (e.g., Frankel, 1997; Hutchinson, 2002;

Mélitz, 2003). Trade networks that reduce search and other information costs have historically developed along these lines of cultural familiarity (see, e.g., Rauch, 1999; Rauch, 2001; Rauch and Trindade, 2002). Part of the literature has pointed out the importance of these networks for international trade, which provides support for the relevance of intangible barriers to trade (e.g., Rauch, 1999; Combes et al., 2002; 2005). The network view argues that, due to incomplete information on distant markets, search processes are important in order to match buyers and sellers. Networks facilitate the search for suitable trade partners and reduce the costs of trade. As a result, understanding the characteristics and development of networks is important to explain the observed patterns of trade. The costs of search tend to vary according to the type of product traded. The search costs for a trade partner are higher for differentiated products, the international market conditions of which are least transparent.

Differences in values and norms constitute the second aspect of cultural differences. The influence of values, informal norms and trust on economic performance and growth has received a lot of attention over the past decade. The comparative literature on the effects of culture on national or regional economic performance focuses on differences in average trust levels or social capital (the potential for cooperative behaviour and trust) between societies (e.g., Putnam, 1993; Fukuyama, 1995; Beugelsdijk and Van Schaik, 2001; Francois and Zabojnik, 2005). On the importance of trust, Granovetter (1985, p. 484) states that "conflict-free social and economic transactions depend on trust and the absence of malfeasance". Furthermore, Knack and Keefer (1997, p. 1252) cite Arrow, "Virtually every commercial transaction has within itself an element of trust, certainly [..] (when) [..] conducted over a period of time. It can be plausibly argued that much of the economic backwardness in the world can be explained by the lack of mutual confidence". Empirical studies have shown that trust and civic norms of cooperative behaviour are important elements in explaining growth differences across countries and over time (e.g., Knack and Keefer, 1997; Beugelsdijk et al., 2004; Tabellini, 2005).

Apart from average trust levels with respect to other people in general, bilateral trust is important for international trade. If countries share cultural values, they have similar informal norms, conventions and procedures of business. Hence, cultural similarity increases trust and mutual understanding, and lowers transaction costs. The importance of trust and social capital for international trade is clearly expressed by Ostrom (2000, p. 144), who states, "most contractual relationships – whether for private or public goods – have at least an element of this basic structure of trying to assure mutual trust", since if trust were lacking "[both] players will end up with lower payoffs than if they had been able to trust and cooperate". By generating trust, cultural similarity reduces psychic distance and creates further trade-enhancing effects, in addition to the reduction in trade costs that follows from familiarity between cultures. A recent study by Guiso et al. (2004) shows that cultural similarity indeed generates higher mutual trust. They use religious similarity, and genetic similarities that capture broad ethnic history, to measure cultural proximity. An empirical investigation of the effect of trust on bilateral trade by Den Butter and Mosch (2003), using data from the World Values Survey, shows that both the average level of trusting behaviour and bilateral trust increase trade. Instead of focusing on trust levels, several studies intend to analyse the impact of differences in cultural values on trade directly, using cultural attributes to proxy cultural similarity or distance. For example, Boisso and Ferrantino (1997) use a measure of linguistic distance to proxy cultural distance, and find that larger linguistic distance reduces bilateral trade. Their argument does not primarily aim at establishing whether two countries can easily communicate, but uses language groups to identify cultural groups within and across countries. Srivastava and Green (1986) argue that common predominant language or religion proxy cultural similarity, and show a positive effect. Guo (2004) investigates bilateral trade patterns of China and the U.S., including indicators of both linguistic and religious similarity to proxy for cultural similarity. Research on co-ethnic networks and migration provides further evidence on the importance of cultural ties for bilateral trade patterns (e.g., Gould, 1994; Rauch and Trindade, 2002).

The previous sections have illustrated how intangible barriers to trade, related to variation in the quality of the institutional environment, lack of information and knowledge on foreign cultures, and distance in terms of cultural values and norms, raise economic distance, and affect transaction costs of trade. Institutional barriers refer to the fact that trade involves different legal and regulatory systems, which raises insecurity of property rights and of contract enforceability and increases transaction costs. As a consequence, variation in the effectiveness of the institutional environment in terms of reducing insecurity is an important barrier to trade. Cultural familiarity barriers reflect that information and knowledge of foreign markets is scarce relative to the domestic market. Unfamiliarity between cultures rises with language differences, lack of historical ties and across physical distance. This leads to adjustment costs and search costs, and lowers bilateral trust in trade. In fact, the border may be a cognitive barrier in itself, explaining why it has a discrete effect on trade (Nijkamp et al., 1990; Van Houtum, 1998). Cultural differences also reflect differences in underlying values and norms, which causes barriers related to trust and understanding, and raises the costs of interaction and trade.

As discussed in Chapter 1, this thesis purports to investigate the relevance and importance of these intangible barriers, in terms of their effect on trade. For this, we need to analyse the determinants of bilateral trade patterns empirically. The so-called gravity model of bilateral trade is the empirical tool for this type of analysis. The next section introduces the gravity model and discusses the theoretical background of the model.

2.4 The gravity model

2.4.1 Background

The gravity model of bilateral trade has become the workhorse model of applied international economics (Eichengreen and Irwin, 1998). This model was originally inspired by Newton's gravity equation in physics, in which the gravitational forces exerted between two bodies depend on their mass and distance. The basic idea of gravity can be used to model spatial interaction in social sciences as well. The gravity model has been used extensively in regional science to describe and analyse spatial flows of information, goods and persons (see, e.g., Greenwood, 1975; Nijkamp and Reggiani, 1992; Isard, 1999), and was pioneered in the analysis of international trade by Tinbergen (1962), Pöyhönen (1963) and Linnemann (1966).

The traditional gravity model relates bilateral trade flows to the GDP levels of the countries and their geographic distance. The levels of GDP reflect the market size in both countries, as a measure of 'economic mass'. The market size of the importing country reflects the potential demand for bilateral imports, while GDP in the exporting country represents the potential supply of goods from that country; geographic distance reflects resistance to bilateral trade. The familiar functional form from physics is then used to relate bilateral trade to these variables of economic mass and distance, as in equation (2.1):

$$T_{ij} = K \cdot \frac{Y_i^{\alpha} Y_j^{\beta}}{D_{ij}^{\delta}}, \tag{2.1}$$

where T_{ij} stands for export from country i to country j; K is a scalar; Y represents the level of GDP and D_{ij} reflects physical distance between the countries.

Usually, the gravity equation is expressed in logarithmic form, for the purpose of empirical estimation. The transformed basic gravity equation, used in estimation, then looks as follows:

$$\ln(T_{ij}) = \ln K + \alpha \ln(Y_i) + \beta \ln(Y_j) + \delta \ln(D_{ij}) + \varepsilon_{ij}, \tag{2.2}$$

where ε_{ij} is a disturbance term that reflects random deviations from the underlying relation.

In general, we can imagine other variables of economic mass and economic distance that affect the intensity of bilateral trade. For example, population levels and income per capita can be thought of as alternative indicators of market size. To represent economic distance, the gravity equation has been extended with various trade-enhancing and trade-resisting factors, such as common language, colonial ties, common religion, trade bloc membership and bilateral import tariffs. This thesis intends to make use of the gravity equation to investigating the effect of institutional and cultural barriers on patterns of bilateral trade. Therefore, we will extend the gravity equation with variables that reflect institutional quality, institutional distance and cultural distance.

The model has worked well empirically, yielding sensible parameter estimates and explaining a large part of the variation in bilateral trade (Rose, 2005). However, the traditional gravity equation as described above has been motivated only on the basis of an intuitive analogy between spatial interaction in physics and in economics. It is not a-priori obvious from a theoretical point of view which indicators of economic mass and distance are relevant, and how they relate to bilateral trade. Therefore, the traditional gravity equation has long been regarded as an empirical model, without solid theoretical foundation. By now, though, the model has received solid theoretical support as well. As argued by Deardorff (1998), the model is sensible, intuitive, and hard to avoid as a reduced form of any theoretical model to explain bilateral trade. We now take a closer look at the theoretical derivation of the gravity equation as a description of bilateral trade. In this way, we gain insight in how bilateral trade depends on market size in both countries and how barriers to trade affect bilateral trade. The derivation of the gravity equation from trade theory set out below follows Feenstra (2004, Chapter 5).

2.4.2 Theoretical underpinning of the gravity equation

Most of the theoretical literature on bilateral trade has focused on the derivation of the gravity equation from models of imperfect competition and product differentiation (e.g., Bergstrand, 1985; Helpman and Krugman, 1985 and Anderson and Van Wincoop, 2003). However, the model is also consistent with Heckscher-Ohlin trade theory under perfect competition (Deardorff, 1998). To derive the gravity equation for bilateral trade patterns most straightforwardly, trade models have to rely on complete specialization. This implies that each country produces different products, ensuring that all countries will in principle trade with all other countries. The most obvious setting for this would be a model of monopolistic competition, in which most trade consists of different varieties of similar products (so-called 'intra-industry trade'). However, the same setting arises from a Heckscher-Ohlin model with a continuum of goods when factor prices do not equalize (see Feenstra, 2004; Deardorff, 1998).[3] In short, the gravity equation can be derived from both neo-classical and new trade models as a reduced-form equation that describes bilateral trade patterns.[4]

Consider a world in which countries are specialized in different (varieties of) products. For simplicity, assume further that consumer preferences are identical and homothetic across countries, and that all products enter symmetrically in consumer utility, which we assume to be a CES specification. Because we assume that all countries produce unique product varieties, any product k is produced exclusively in a specific country i. The consumption of product k in any country j then equals the export of product k from country i to country j. Thus, we may define the total consumption in country j of product k as c_k^{ij}. Suppose that country $i \in \{1,.....,C\}$ produces N^i products. The total utility from consumption in country j can then be represented by:

$$U^j = \sum_{i=1}^{C} \sum_{k=1}^{N^i} \left(c_k^{ij}\right)^{(\sigma-1)/\sigma} , \tag{2.3}$$

where σ is the elasticity of substitution between any two products, which we take to be larger than 1.

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3 The assumption that factor prices are unequal in equilibrium can be motivated by the existence of trade barriers. To ensure complete specialization, such that all countries in principle trade with each other in a Heckscher-Ohlin world with trade barriers, a necessary condition is that factor prices do not equalize (Deardorff, 1998, p. 17).

4 As shown by Bröcker (1989), an expenditure system based on microeconomic optimization does not necessarily reduce to the gravity equation. However, he shows that the gravity equation is generally consistent with such optimizing behaviour. The relative simplicity in use and empirical success of the gravity equation then provide ample arguments to prefer it in empirical work. In fact, the gravity equation holds under fairly general assumptions. Trade costs that are proportional to the value of trade; CES demand with identical share parameters and elasticities of substitution for all destinations, and price taking on the demand side will suffice. We will derive the gravity equation in a Dixit-Stiglitz model of monopolistic competition with 'iceberg' trade costs, which is an analytically convenient special case consistent with these assumptions.

We assume that production of good k in country i requires only labour as input (L_i), according to the following relation, which we take to be equal across all goods and countries:

$$L_i = \alpha + \beta y_i \,, \tag{2.4}$$

where y_i stands for total output of good i, α is the fixed labour input needed in production and β is marginal labour required in country i.

Because the production is characterized by economies of scale, and product varieties are differentiated from one another, we assume monopolistic competition between firms, each producing a unique product variety. Free entry of firms, introducing new varieties, ensures that profits will be zero for each firm in equilibrium. Firms then produce up to the point where marginal costs equal marginal revenue. This leads to the familiar condition from microeconomics, that:

$$p^i\left(1-\frac{1}{\eta}\right) = w^i\beta, \text{ or } \frac{p^i}{w^i\beta} = \left(\frac{\eta}{\eta-1}\right), \tag{2.5}$$

where η is the price elasticity of demand, and w^i is the equilibrium wage rate in country i.

Now, the specific form of the utility function chosen comes in handy. The elasticity of substitution between varieties, σ, is equal to the elasticity of demand when the total number of varieties available to consumers is sufficiently large. As a result of the constant elasticity of demand, the mark-up of prices over marginal costs is fixed at $\left(p^i \big/ \left(\beta w^i\right)\right) = \left[\sigma/(\sigma-1)\right]$. As a result, using the zero profit condition, $\pi = p^i y^i - w^i(\alpha + \beta y^i) = 0$, we can derive that output of all goods is fixed at:

$$\bar{y} = (\sigma - 1)\alpha/\beta \,. \tag{2.6}$$

Note that all firms will set the same mill price for their product for both the domestic market and all export markets, because of the constant elasticity of demand. Because production costs are the same for all goods produced in country i, all products from country i sell at the same price p^{ij} in country *j*. Given the symmetry of preferences in (2.3), consumption in country *j* is also equal over all products sold by country *i*, which allows us to drop the subscript on consumption in the utility function: $c_k^{ij} = c^{ij}$.

The utility function then simplifies into:

$$U^j = \sum_{i=1}^{C} N^i \left(c^{ij}\right)^{(\sigma-1)/\sigma} . \tag{2.7}$$

To determine the patterns of bilateral trade in this setting, we first introduce the notion of trade barriers into the model. We have argued that all products exported by country *i* sell for the same price in country *j*. However, this price is in general not the same as the price paid by domestic consumers for products produced locally. The reason is that barriers to trade raise the price paid by consumers in country *j*, because they lead to trade costs. The effect of trade barriers are usually modelled using the "iceberg" trade costs formulation. If consumers in country *j* want to consume one unit of a product produced in country *i*, τ^{ij} products have to be shipped to country *j*, where $\tau^{ij} > 1$. The difference $\left(\tau^{ij} - 1\right)$ "melts away" during the transaction, as an iceberg when it drifts to warmer waters. Thus, the effective price paid in country *j* includes all trade costs. This price is known as the c.i.f. (costs, insurance, freight) price. This price equals the mill price multiplied by the bilateral trade costs factor τ^{ij}:

$$p^{ij} = \tau^{ij} p^i . \tag{2.8}$$

Consumers in country *i* itself, though, are assumed to pay just the mill price set by the firm based on production costs. This price is also labelled the f.o.b. (free on board) price. In other words, we assume that domestic trade does not suffer from trade barriers (i.e., $\tau^{ii} = 1$).[5]

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[5] In general, we assume that domestic trade suffers from smaller barriers than international trade. As a result, we will observe a "border effect" (see section 2.1), as domestic trade is less costly than international trade, all else equal. Moreover, bilateral trade will be relatively large, if bilateral trade barriers are relatively small.

We can now proceed to derive the relation that describes bilateral trade. Consumers in country *j* maximize utility (2.7), subject to the budget constraint that their total expenditure on all goods equal national income (i.e., we assume balanced trade):

$$Y^j = \sum_{i=1}^{C} N^i p^{ij} c^{ij} \,, \tag{2.9}$$

where Y^j is aggregate expenditure and income in country *j*.[6]

The outcome of utility maximization then results in the following expression for the demand of any good from country *i*, c^{ij}:

$$c^{ij} = \left(p^{ij} / P^j \right)^{-\sigma} \left(Y^j / P^j \right), \tag{2.10}$$

where P^j represents the general price level in country *j*, defined as a CES price index:

$$P^j = \left(\sum_{i=1}^{C} N^i \left(p^{ij} \right)^{1-\sigma} \right)^{1/(1-\sigma)} . \tag{2.11}$$

Equation (2.10) describes the export volume from country *i* to country *j* of a specific product variety. It states that more will be demanded by country *j*, when the price of goods imported from country *i* is low, compared to the overall average price level over all varieties, and when the real income level in country *j* is high.

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[6] In this stylized model, total expenditure equals total income in value added terms. Hence, the model assumes that all transactions are in terms of final goods. In empirical applications, however, the total value of (international trade) transactions includes the value of intermediate goods that are embedded in final goods. Hence, export potential is accurately represented by gross output, while total expenditure should equal total use, including intermediates. However, as is common in the literature, we will use GDP in both countries instead, which is expressed in value added terms, while bilateral trade statistics are in terms of gross value. Thus, we assume that gross output and total use come in roughly constant ratios to GDP across countries. If this assumption is invalid, parameter estimates may be biased (see, e.g., Anderson and Van Wincoop, 2004, p. 728; Yi, 2003).

From the results on the individual product level, we can derive an expression for total bilateral trade between countries i and j. This will generate the gravity equation. The total value of exports from country i to country j, on a c.i.f.-basis, by definition equals:

$$T^{ij} \equiv N^i p^{ij} c^{ij} . \tag{2.12}$$

Substituting equation (2.10) into equation (2.12), we arrive at:

$$T^{ij} = N^i Y^j \left(\frac{p^{ij}}{P^j} \right)^{1-\sigma} . \tag{2.13}$$

As equation (2.6) implies that output levels for any product are fixed, it follows that GDP in country i is equal to:

$$Y^i = N^i p^i \overline{y} , \tag{2.14}$$

Substitution of equation (2.14) into equation (2.13) yields the gravity equation, relating bilateral exports to market sizes and trade barriers:

$$T^{ij} = \frac{Y^i Y^j}{p^i \overline{y}} \left(\frac{p^{ij}}{P^j} \right)^{1-\sigma} = \frac{Y^i Y^j}{\left(p^i\right)^{\sigma} \overline{y}} \left(\frac{\tau^{ij}}{P^j} \right)^{1-\sigma} . \tag{2.15}$$

We can infer that trade rises proportionately with GDP levels, and declines with trade costs, caused by barriers to international trade. Expressed in logarithmic form, the gravity equation for empirical estimation becomes:

$$\ln(T^{ij}) = -\ln(\overline{y}) + \ln(Y^i) + \ln(Y^j) - (\sigma - 1)\ln(\tau^{ij}) + (\sigma - 1)\ln(P^j) - \sigma \ln(p^i) + \varepsilon_{ij} . \tag{2.16}$$

We have shown that the gravity equation can be derived from economic theory. The resulting gravity model is also referred to as 'generalized gravity', as it is theoretically consistently derived. Most noteworthy, the generalized gravity equation differs from the traditional gravity equation (2.2) because it includes the price levels of the importing and exporting countries. Bilateral trade depends not only on the c.i.f. price of bilateral import, but also on the average import price from all other export sources (P^j), due to a substitution effect, and the mill price in the exporting country (p^i), which indirectly reflects the number of varieties on offer from the exporting country (at a constant level of Y^i and τ^{ij}).

Estimation of equation (2.16) requires variables to reflect price levels. However, direct data on price levels are problematic. Most data on general prices are expressed as price indices, relative to some base year. These indices are not comparable internationally, though. A higher price index level in some year does not say much about the actual price level compared to other countries, because they do not convey information on price levels, expressed in an internationally comparable unit, in the base year. Alternatively, the country-specific price levels can be captured by using country-specific effects. However, the disadvantage of this approach is that all country-specific variables drop out of the equation, as their effect is captured by the country dummies.

In the gravity equations we estimate in Part II of this thesis, we choose a pragmatic approach. In order to be able to investigate the effect of institutional quality on bilateral trade, we extend the traditional gravity equation (2.2) by variables that reflect institutional quality levels. Using fixed effects, these variables drop out of the specification. However, we use fixed effects at times, to check the robustness of our results with respect to the other barriers to trade, such as institutional distance, cultural familiarity, bilateral import tariffs and physical distance.

The relation between trade costs and the underlying barriers to trade identified in this thesis and in the gravity literature can be illustrated by considering that trade barriers raise the costs of trade, which may be modelled as:

$$\ln(\tau^{ij}) = b^{ij} + \rho \ln(D_{ij}) + \mu_{ij}\,, \tag{2.17}$$

in which D_{ij} stands for physical distance, and b^{ij} represents other dimensions of economic distance between country *i* and *j*, such as caused by institutional trade barriers and cultural barriers, in terms of the effect on trade costs (μ_{ij} stands for residual unexplained trade costs). Thus, we have illustrated that the gravity model is a theoretically sound and empirically natural model to investigate the importance of trade barriers, in terms of their effect on bilateral trade patterns.[7]

2.5 Some concluding remarks on intangible barriers to trade

In this chapter, we have introduced the intangible barriers to trade that have a central position in the subsequent empirical chapters of the thesis. Barriers of incomplete information and cultural familiarity are associated with the crossing of nation borders and geographic distance. Because international transactions move across jurisdictional boundaries, property rights protection and contract enforcement are more difficult. As a result, insecurity is higher in international trade than for domestic exchange. Variation across countries in the institutional

[7] Equation (2.17) illustrates the step necessary to get from the theoretically derived gravity equation (2.16) to the conventional gravity equation (2.2), where trade is related to distance in a power function (i.e., a linear relation in double logarithmic form). This step is conceptually problematic, though. It implies that the trade-costs factor τ_{ij} will tend to zero when distance approaches zero. This also implies that c.i.f.-prices will approach zero, and trade will go to infinity. Clearly, this is unrealistic. A more realistic specification of the distance effect would relate distance directly to the tax equivalent of trade costs (Grossman, 1998; Anderson and Van Wincoop, 2004, p. 730). This would imply: $\tau_{ij} \equiv 1 + t_{ij} = 1 + \eta D_{ij}^{\rho}$. In this specification, the tax equivalent of trade costs (i.e., the trade costs per euro of shipments) approaches zero if distance comes close to zero. The drawback of this specification is the non-linearity of the resulting gravity equation. An alternative that allows linear estimation is to assume an exponential relation between trade and c.i.f.-prices, rather than a power function (e.g., Bröcker and Rohweder, 1990). A related problem is the normalization of the internal trade-costs factor τ_{ij} to one. In specification (2.17), this implies that we set internal distances equal to one. In the alternative specification of trade costs proposed here, the normalization of τ_{ij} implies that internal distances are set equal to zero. In fact, we only normalize internal trade costs, because we do not consider intranational trade in our empirical analysis. Because we confine our analysis to international trade, the normalization only implies that internal distances are assumed to be equal across countries. In fact, internal distances vary across countries, and hence affect their openness to trade (intranational versus international trade). Specifications using country dummies will pick up these general openness effects. Because internal distance will normally be correlated to bilateral distance, the parameter estimates for the gravity equation may be biased. Regressions in Chapter 6 that include land area as proxy for additional transport costs do not change the results much, though.

safeguards of property rights and contract enforcement provides an important cause for cross-country differences in the level of insecurity of trade. Finally, differences in cultural values and norms between countries reduce bilateral trust and increase adjustment costs in trade. This poses a cultural distance barrier to trade.

All these barriers to trade are interrelated in some sense. For example, there is an interesting link between the incomplete-information and institutional barriers to trade. Incomplete information, especially if asymmetric as well, provides the motivation to develop formal institutions to structure exchange. However, historically, this has also motivated the development and spread of international trade networks, as informal modes of cross-border governance and enforcement (e.g., Greif, 1993; Greif et al., 1994). The general idea is that information on opportunistic behaviour and reputation building within networks matter for the enforcement and stimulation of cooperative behaviour (Rauch, 2001; Anderson and Marcouiller, 2002). Networks as enforcement mechanisms only work well up to a point, though. In order to allow trade to expand ever further across borders, informal private solutions do not suffice and investment in formal institutions becomes necessary (Dixit, 2004). The complementarity between incomplete information and insecurity, and the potential trade off between networks and institutions to enforce cooperative outcomes constitute the background for our analysis in Chapter 5. In that chapter, we analyse the importance of networks and institutions for trade in different types of products. Because of higher trade-relation-specific investments, insecurity is higher for trade in differentiated goods. The specific investments cannot be secured via network enforcement alone, which suggests that formal institutions are relatively more important for lowering barriers to trade in differentiated products.[8]

Psychic distance barriers caused by cultural unfamiliarity and cultural distance are related as well. Both familiarity between cultures and similarity in cultural values and norms increase

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[8] In a paper that closely resembles the topic addressed in Chapter 5, Berkowitz et al. (2003) argue that institutional quality not only affects transaction costs in differentiated-products trade most, but can also affect comparative advantage in these products.

bilateral trust, reduce search and other information costs and hence reduce cultural barriers to trade. As a result, it is difficult to disentangle the different barriers. Language and ethnic origin can be used to identify similar cultural groups, but also serve to increase cultural familiarity and facilitate communication. For example, the importance of international trade networks first and foremost illustrates the benefits of cultural familiarity. Co-ethnic networks and migrant ties reduce information costs to enter into otherwise unfamiliar foreign markets. Trust can also be related to both aspects of cultural differences, as well as to the institutional environment. Similarity in cultural values and norms creates bilateral understanding and approval, which raises bilateral trust. On the other hand, cultural familiarity can generate bilateral trust, because traders are acquainted with business practices in both countries. Finally, the formal institutional environment is important for the general level of trust and confidence in doing business as well (Knack and Keefer, 1997). Effective protection of property rights, impartial government regulation and adequate contract enforceability generate an environment that better enables economic agents to trust each other in exchange. This type of trust is known as formal or external trust, or confidence (Nooteboom, 2002; Mosch, 2004).[9] Furthermore, bilateral homogeneity of institutional quality can also generate confidence and

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[9] Opposite to the positive effect of formal institutions on trust, Ostrom (2000) notes the possibility that formal institutions can crowd out informal norms and trust. This indicates the importance of the historical relation between informal trust and norms, and formal institutions. In some situations, a system of cooperative social norms, based on internalized values and informal trust, spontaneously emerges and propagates cooperative behaviour. This setting can be created, for example, by informal institutions that signal ‘good behaviour’, such as social networks. If formal institutions are imposed externally, or ‘top-down’, to substitute the informal system of norms and trust, the result can be that norms break down, dissipating informal trust and spontaneous cooperation. The alternative to enforce cooperation through formal rules can very well be difficult and costly, if effective at all. This stresses the importance of a ‘bottom-up’ genesis of formal institutions, to complement and reinforce existing informal mechanisms. An example on a micro-scale: the author of this thesis recently witnessed a friend being fined for a traffic rule violation, while he dropped me off at the train station. Any attempt to convince the officer of our good intentions – we missed a traffic sign because we did not know the site and were searching for the right direction – proved useless. He took the formal stance, and did not show any belief that we were trustworthy. This affected my informal trust negatively, not only in that officer or officers in general, but in the whole point of taking effort to act cooperatively. In that way, trust in fellow citizens might wither away gradually, and disappear altogether in the end, possibly raising transaction costs and lowering productivity.

informal trust, because of the acquaintance with informal business procedures and norms developed to operate effectively within the institutional environment.[10] The effect of institutional proximity or institutional distance on the level of bilateral trust in successful exchange provides the motivation to explicitly consider the relation between institutional distance and trade in Chapter 4.

2.6 Investigating barriers to trade: an outline of the empirical analysis

We argue in this thesis that three types of intangible barriers are especially relevant for explaining the apparent resistance to international trade: cultural familiarity and other informational barriers, institutional barriers and cultural distance barriers. These barriers affect the ease of realizing successful matches in trade, the (self-)enforcement of cooperative behaviour and commitment to mutual benefits in trade, and the risks of expropriation or other misappropriation of private gains in trade. In short, they determine the success in solving what Greif (2000) calls the fundamental problem of exchange. The gravity model of bilateral trade provides the analytical tool to analyse the impact of these trade barriers on the patterns of trade. The model describes bilateral trade as a function of market size and economic distance, and can be consistently derived from economic theory.

As a consequence of the diverse interrelations between institutions, cultural familiarity and cultural similarity, using indicators of trust levels or language and ethnic origin does not allow us to identify the underlying barrier to trade, only to proxy for a diversity of intangible trade barriers. The following chapters intend to separately identify and analyse the specific intangible trade barriers.

Chapter 3 focuses on the size and development over time of the distance barrier to trade, as the most prominent summary-measure of barriers to trade, and gives a first illustration of the importance of a variety of intangible informational and cultural barriers to trade. This chapter

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[10] Confidence or informal trust generated by institutional similarities can also arise from similar formal legal systems, based on historical legal origin (see La Porta et al., 1999; Den Butter and Mosch, 2003). Note that this does not necessarily imply that institutional quality is comparable in both countries, nor vice versa.

provides the starting point for further empirical analysis of intangible barriers to trade. We perform meta-regression analysis to determine whether the distance effect differs over time and according to the estimation and specification characteristics used in the existing literature. For example, primary-study control variables may be correlated to physical distance and affect the estimated effect of distance. Meta-analysis is a combination of methods to perform statistical analysis on a collection of existing empirical estimates of a similar effect – in our case, the distance effect on trade (see Glass, 1979).

In Chapter 4, we estimate gravity equations to investigate the institutional barriers to trade, using a database on trade between pairs of countries and on their country-specific and bilateral characteristics.[11] More specifically, we study the effect of institutional quality and institutional distance on bilateral trade. These variables affect the level of security of property rights and contract enforceability, and the related extent of formal trust (confidence) and informal trust (as generated by similar informal norms and familiarity with the institutional environment). As a result, transaction costs in trade depend on institutional quality and institutional distance. Moreover, the investigations also include an assessment of the role of GDP per capita in the gravity model. Stylized facts indicate that trade increases with the level of economic development. Furthermore, countries with similar per capita incomes may trade more, because they have similar preferences and produce similar products that serve these preferences best. We will investigate whether institutions are responsible for the tendency of rich countries to trade more than can be explained by the basic gravity relationship, and whether institutional distance and differences in GDP per capita have separate effects.

Chapter 5 deals with the variation in the impact of institutional barriers across different types of products traded, notably homogeneous versus differentiated goods. This captures the idea that incomplete information and insecurity interact in raising the resistance to trade. We propose that institutions are most important for trade in differentiated products, as compared to trade in homogeneous goods. Because of higher trade-specific investments in search and

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[11] The Data Appendix at the end of this thesis provides further details on the database used in this thesis.

adjustment costs, the risk of opportunistic behaviour and the costs of trade are higher in differentiated goods trade. Thus, international trade networks and institutions are more important for controlling these costs, and search for matching trade partners will concentrate more on potential partners in high quality institutional settings. Empirically, the analysis determines the relative importance of institutional barriers to trade across product groups, both for explaining bilateral trade and the occurrence of zero-trade. The approach followed for explaining zero flows provides insights on how to deal with observations of country-pairs that do not trade in a certain product class, or do not trade at all.

The analysis in Chapter 6 focuses on cultural barriers to trade, notably the cultural distance barrier posed by differences in underlying cultural values and norms. Cultural distance leads to variation in adjustment costs and informal trust levels, which follow from misunderstanding, lack of mutual approval and differing expectations of behavioural conventions and procedures, due to differences in values and social norms. Focusing on indicators of work-related values and norms, we intend to capture this aspect of cultural differences explicitly. This approach supplements earlier efforts that use religion to reflect underlying cultural values. We focus on trade barriers related to differences in cultural values, rather than trade barriers that may arise from certain values and cultural attitudes *sec*.[12] The motivation is twofold. First, cultural distance reflects a relevant *bilateral* barrier to trade. Second, the institutional quality variables capture international trade barriers that are *country-specific*, and may have a cultural origin. In fact, opinions differ as to whether culture underlies institutions, or vice versa, and we can probably conclude that the relation operates in both directions (see, e.g., Greif, 1994; Acemoglu et al., 2001 and Tabellini, 2005). Therefore, we

[12] An alternative approach is adopted in a recent study by De Jong et al. (2005), who investigate the relation between individual cultural attributes and openness to trade. The results indicate, for example, that individualist societies are more open to trade, while risk averse societies are on average less inclined to engage in international transactions. Whether this reflects that individualist societies have invested more in formal institutions and thus reduced insecurity in trade (see Greif, 1994), or reflects a general attitude towards trade, is unclear. Perhaps these explanations interact if, for example, risk averse societies have a more negative perception of institutional quality and security in trade, all else equal.

include institutional quality to reflect these country-specific trade barriers, whether they originate from cultural history, operate through institutions, or through cultural traits such as general trust.

The final chapter in this thesis summarizes the empirical findings and considers the results in relation to the research questions posed in Chapter 1. We also consider the questions and puzzles that remain and make some suggestions for further research.

Chapter 3

Distance Decay in International Trade Patterns: A Meta-Analysis[1]

3.1 Introduction

In the previous chapters, we discussed the stylized fact that physical distance strongly conditions bilateral trade. Thus, the distance effect in trade is the primary candidate to explain the resistance to trade. Apart from the size of the distance effect in trade, the development over time has been the subject of much attention in the literature as well. The analysis in this chapter intends to enhance our understanding of the impact of distance-related trade barriers on bilateral trade. Using meta-analysis, this chapter investigates the existing empirical evidence on distance decay from the gravity-model literature on bilateral trade. We address three issues that emerge from the empirical literature. First, the size of the distance effect on trade is surprisingly high, if to be explained by physical transport barriers alone. This suggests that intangible distance barriers are important to understand the size of distance decay in trade (Frankel, 1997; Grossman, 1998). Barriers of cultural unfamiliarity and incomplete information increase with geographic distance between countries. As a result of unfamiliarity over large distances, less information is exchanged between countries and the lack of information on distant markets and culture is reinforced. Because of the large effect on

[1] This chapter is based on Linders et al. (2005d); and Linders et al. (2004).

bilateral trade patterns, the distance effect illustrates the relevance of intangible informational and cultural barriers to trade.

Second, the estimates of the distance parameter in gravity equations of bilateral trade vary widely across the literature. Literature reviews sometimes make statements about the 'typical' distance decay estimate across the literature. According to Leamer and Levinsohn (1995), the estimates are generally close to 0.6, which implies that trade falls with 0.6% if distance increases by 1%. Frankel (1997) reports a representative distance elasticity of 0.75.[2] In fact, though, estimates of distance decay vary widely in the literature on bilateral trade patterns. For example, Frankel (1997, p.71) reports that distance decay estimates are lower in magnitude (varying between 0.5 and 0.7) once the gravity equation controls for contiguity. Moreover, the distance parameter in the gravity model may capture the effect of various omitted trade-enhancing variables that cluster in space (for example, preferential trade agreements), or spread over long distances (such as historical colonial links). To indicate the variation across the literature, he reports estimates for various studies that range between 0.35 and 1.5. Thus, the effect does not appear to be a natural constant, but depends on the time period considered, the specification of the gravity model and the estimation characteristics in the primary study.

Finally, the distance barrier has remained persistently high over time, despite falling costs of transport and communication. Advances in transportation technology and ICT have vastly reduced the costs of transport and communication over the past decades. As a result, we would expect that the distance effect on trade has diminished over time. Yet, the empirical evidence does not provide a clear indication of a downward trend in distance decay. Rather, the effect proves to be very persistent (Carrere and Schiff, 2003; Berthelon and Freund, 2004). Surprisingly, some studies even indicate that the effect has risen over time (e.g., Brun et al., 2002).

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[2] The effect size of distance decay is expressed as a positive number throughout this chapter, since we aim to focus on the magnitude of the effect. Distance reduces trade, so a higher effect size implies a larger reduction of trade for a given increase in geographic distance.

The remainder of Chapter 3 is organized as follows. In section 3.2, we briefly introduce meta-analysis as a secondary research method to quantitatively review the existing literature. Section 3.3 describes the sample of studies included in the meta-analysis. In section 3.4, we present the meta-regression results. Finally, section 3.5 draws conclusions on the inferences that can be made.

3.2 Meta-analysis

3.2.1 Background

Meta-analysis is a set of methods for quantitative research synthesis of the existing evidence on a common effect in the literature (Stanley, 2001). The methods of meta-analysis are well suited to draw conclusions about the effect of geographical distance on trade flows, from the body of empirical studies performed until now. Glass (1976) stated that "meta-analysis refers to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings". In other words, meta-analysis is a statistical analysis of existing empirical results on a specific topic. A meta-analysis starts from the observed cross-study variation in effect size estimates, and tries to account for this variation by considering differences in research design and specification. Meta-analysis has been widely used in medicine and experimental sciences and has increasingly been applied in economics over the past 15 years. Applications of meta-analysis have appeared, for example, in environmental economics (e.g., Smith and Huang, 1995; Van den Bergh et al., 1997), labour economics (Card and Krueger, 1995; Ashenfelter et al., 1999; Longhi et al., 2004), transportation economics (e.g., Brons et al., 2005) and in macroeconomics of economic growth (e.g., Nijkamp and Poot, 2004). Recently, meta-analysis has been used in the empirical literature on international trade as well, to analyse the effects of trade on growth (Lewer and Van den Berg, 2003) and the effect of currency union membership on bilateral trade (Rose, 2002).

Given the widespread application of the gravity model to investigate the patterns of international trade, meta-analysis can be a very useful method to acquire new insights (Florax et al., 2002; Stanley, 2001). For example, Rose (2002) used meta-analysis to summarize the current state of affairs regarding the impact of common currencies on bilateral trade. The meta-analysis provided new insight on the hotly debated question whether the positive effect of currency union membership on bilateral trade is robust across the literature and can be generalized to various countries, regions and time periods. We will use meta-analysis to statistically investigate variation in empirical evidence on distance decay that emerges from the literature on bilateral trade.[3] Using meta-analysis, we can make statistically supported inferences about the impact of distance on trade, the variation across the literature and its development over time. In this way, we intend to contribute to the debate on the size and persistence of distance decay in trade.

3.2.2 Methods

The quantitative methods of meta-analysis enable us to combine and evaluate empirical results on a common effect across a sample of different studies. The sample of observations on the distance effect in bilateral trade can be investigated in several ways. The combined effect-size offers a single summary statistic for investigating the size of the distance effect. We are also interested in explaining the variation between primary estimates of distance decay. The combined effect does not enable us to explore and explain the reasons why observations of a common effect vary. Meta-regression methods are designed for investigating whether observations differ systematically over time and according to their estimation, specification and other characteristics. Appendix 3A provides a more detailed discussion of the methods to combine effect sizes and perform meta-regression analysis.

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[3] During the research and writing of earlier versions that led to this chapter, we noticed that a similar meta-analysis, focusing on the trend in distance decay, was performed elsewhere as well (see Disdier and Head, 2003).

3.3 The meta-analysis sample

3.3.1 Sampling

A quantitative literature survey of distance decay in bilateral trade begins with the selection of studies to be included in the analysis. We have conducted a comprehensive search for gravity-equation studies on bilateral trade in *Econlit*, on the keywords ('trade' or 'distance') and 'gravity', extended with additional gravity studies identified from references in these studies (a method sometimes referred to as 'snowballing'). This has resulted in a list of more than 200 studies written in English.[4] Ideally, we would like to include all available studies that estimate distance decay in trade. However, the number of gravity-equation studies of bilateral trade is too large to be easily collected completely. From the list of studies that we retrieved from the literature, we randomly select studies to be included in the sample for the meta-analysis. Random selection enables the efficient construction of a meta-sample that is representative for the underlying comprehensive gross list of retrieved studies. In principle, the sample of studies is extended until the results from the meta-analysis converge, and are robust to the addition or exclusion of single studies. Due to time constraints in constructing the meta-analysis database, we have so far included 19 studies in our analysis, which have been randomly selected.

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[4] The search process has only considered papers that are concerned with aggregate bilateral merchandize trade. Sectoral or product-specific studies are not comparable, because they differ in terms of the dependent variable and not only in terms of estimation and specification characteristics. We cannot expect that distance decay in trade of office supplies is comparable to distance decay in tomatoes (see also Chapter 5). Distance decay in aggregate bilateral trade is comparable across estimates, though. Thus, we do not include papers that focus on a specific sector, industry or product. If we wanted to focus on differences in distance decay between different products, we would investigate a different (in itself very interesting) question than in this meta-analysis. Here, we focus on differences in distance decay related to estimation and specification differences between studies, the time period studied and the geographic area concerned.

Table 3.1 describes the studies in the meta-analysis sample. Most studies present multiple estimation results of the distance decay parameter. Therefore, a total of 287 estimates of the distance decay parameter could be collected from the 19 sampled studies.[5]

Table 3.1 Overview of the distance-effect estimates in the sampled primary studies.

Study	Number of estimates	Mean distance effect	Minimum distance effect	Maximum distance effect
Total sample:	287	0.77	0.03	1.44
Individual studies:				
1. Abraham et al. (1997)	4	0.46	0.18	0.67
2. Anderson and Marcouiller (2002)	6	1.12	1.10	1.13
3 .Van Bergeijk and Oldersma (1990)	4	0.99	0.86	1.06
4. Bougheas et al. (1999)	10	0.57	0.24	0.78
5. Dell'Ariccia (1999)	20	0.20	0.03	0.36
6. Djankov and Freund (2002)	12	0.84	0.42	1.17
7. Eichengreen and Irwin (1998)	31	0.54	0.13	0.98
8. Endoh (2000)	25	0.79	0.35	0.94
9. Frankel and Rose (2002)	5	1.11	1.06	1.22
10. Freund and Weinhold (2000)	49	0.84	0.08	1.13
11. Frankel et al. (1995)	20	0.52	0.35	0.68
12. Hejazi and Safarian (2001)	18	0.70	0.24	0.99
13. Jakab et al. (2001)	6	0.94	0.89	1.01
14. Nilsson (2002)	14	0.64	0.34	0.92
15. Oguledo and MacPhee (1994)	3	0.51	0.25	0.76
16. Raballand (2003)	5	1.21	1.05	1.44
17. Rose (2000)	48	1.11	0.88	1.27
18. Rose (2004)	6	1.21	1.12	1.31
19. Wall (1999)	1	0.94	0.94	0.94

Notes: The distance-decay elasticity of trade has been defined positively. Publication details of the papers can be found in the list of included case studies in Appendix 3A.

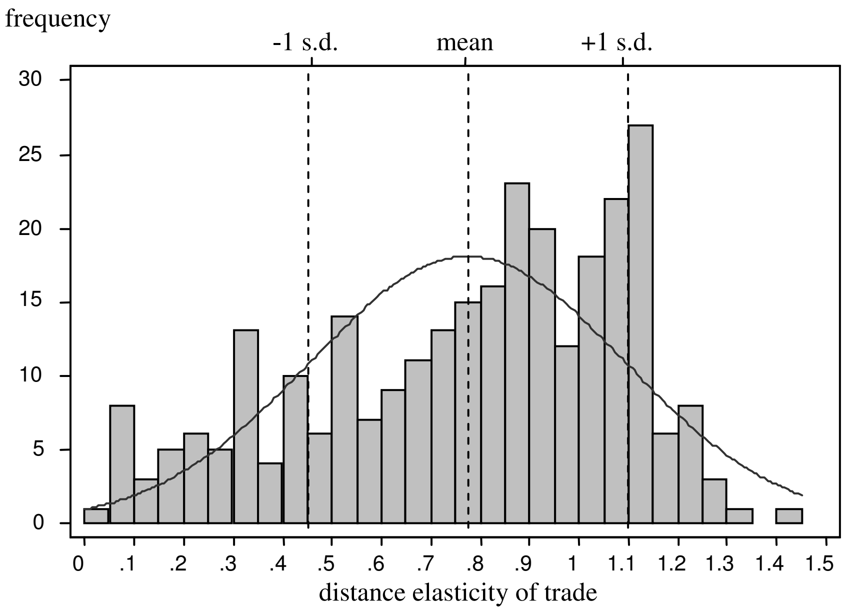
3.3.2 Descriptive statistics

To analyse the distance-decay estimates in our sample, we start with an exploratory analysis of distance decay. First, we compare and combine the estimates sampled from the literature to

[5] It turns out that 8 observations in the initial sample of 301 estimates, which are based on a semi-log specification of the gravity equation, are not comparable to the other (double logarithmic) observations. These estimates have been omitted from the sample. Furthermore, three estimates of which the standard error of the distance-decay elasticity could not be determined have been omitted as well. This concerned two observations from Anderson and Marcouiller (2002) and one observation from Rose (2000). Finally, three additional observations from Rose (2000) were excluded. Two of these are from estimations that Rose has explicitly qualified as unreliable. The third omitted observation from Rose (2000) did not have a clear definition of the measure and unit of distance used. The exclusion of 14 estimates in total leaves a sample of 287 observations.

assess the size and heterogeneity of the effect. Subsequently, we discuss the expectations concerning the development of distance decay over time. Univariate scatter plots provide a preliminary investigation of the trend in the distance effect over time. Figure 3.1 illustrates the frequency distribution of the effect sizes observed in our sample. A normal density curve, based on the sample mean and standard deviation as shown on the top horizontal axis, is plotted as well. The sample distribution has two modes, around 0.87 and 1.1, and is asymmetric, with a heavy left tail.

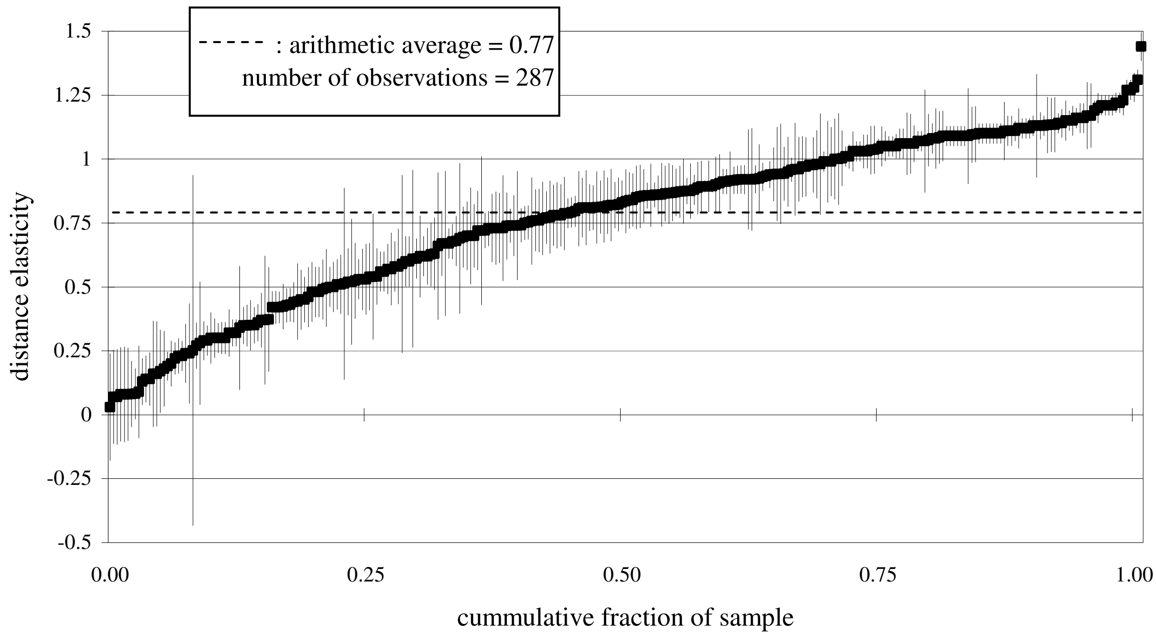
Figure 3.1 Histogram of distance-effect observations



Note: the distance effect size has been defined positively.

Because the observations are widely scattered and do not seem to follow a single-peaked smooth normal distribution, we may expect that the variation in observations cannot be accounted for by sampling error alone. Figure 3.2, a forest plot of the observations, confirms this expectation. The forest plot orders the estimates according to their size. The vertical lines indicate the 95 percent confidence interval around the estimates, denoted by solid squares. The arithmetic mean distance effect in the sample is depicted by a dashed line. The extent of heterogeneity of the estimates is shown clearly by the fact that the mean estimate does not enter into most confidence intervals of the individual estimates.

Figure 3.2 Forest plot of distance decay: effect sizes and confidence intervals



Meta-analysis distinguishes two methods for pooling effect sizes. Both the fixed-effect model and the random-effect model combine the primary estimates and yield a pooled weighted estimate of the common effect. These models differ in the assumptions concerning the underlying true effect that all primary studies are estimating. The fixed-effect model assumes that all studies estimate a single true underlying distance decay parameter. The random-effects model, in contrast, assumes that the observations are estimates of different underlying distance decay effects. In particular, the underlying effect sizes are assumed to vary randomly from a single distribution with fixed mean and variance.

The fixed-effect model integrates the sampled effect-size estimates into a pooled estimate of distance decay ($\bar{D}_{\bullet}$) (see, e.g., Sutton et al., 2000, Chapter 4):

$$\bar{D}_{\bullet} = \frac{\sum_{i=1}^{N} w_i b_{di}}{\sum_{i=1}^{N} w_i}, \tag{3.1}$$

in which b_{di} stands for primary-study estimate i of the distance-decay elasticity in bilateral trade. The observations are given weights proportional to their precision. The weight (w_i) attached to the observation is usually given by the reciprocal of the estimated sampling variance of the primary estimate of the distance parameter:

$$w_i = \frac{1}{s_{di}^2}. \tag{3.2}$$

The weight that should be substituted in equation (3.1) for each primary estimate, in order to estimate the random-effects pooled average includes the estimated random-effects variance of underlying effects, $\hat{\tau}_\beta^2$ (Sutton et al., 2000, Chapter 5):

$$w_i^* = \frac{1}{\hat{\tau}_\beta^2 + s_{di}^2}. \tag{3.3}$$

The combined averages are reported in Table 3.2. The simple arithmetic average of the distance decay effect is given in the first line of the table (see also Table 3.1 and Figures 3.1 and 3.2). At 0.77, it is somewhat higher than the typical value of 0.6 claimed by Leamer and Levinsohn (1995) and comparable to the value of 0.75 reported by Frankel (1997). The distance decay elasticity is significantly different from zero, as can be seen from the 95%-confidence intervals reported. Comparing the simple average to the weighted fixed and random-effect pooled estimate, the fixed-effect estimate is substantially larger, whereas the random-effect estimate resembles the arithmetic average.

Table 3.2 Combining effect sizes

pooled effect size	value	t-statistic	95%-confidence interval
arithmetic	0.774	41.4	0.738–0.811
fixed-effect	0.935	564.5	0.932–0.939
random-effect	0.782	53.9	0.754–0.811
random-effects variance ($\hat{\tau}^2$)	0.06		
Q-statistic (χ^2_{286})	2 x 10^4		

Note: The number of observations in the sample is 287.

The difference between both pooled effect sizes is a further indication of heterogeneity. The fixed-effect estimate assumes that all variation across estimates is due to sampling error in the primary studies. Because observations with a high value for distance decay tend to have a lower sampling variance (see Figure 3.2), the fixed-effect estimate gives higher weight to these observations, which pushes the pooled effect upwards.[6] However, the differences between the observations cannot be justified by sampling error alone. The random-effect combined estimate acknowledges that random-effects variance explains part of the gap.

To assess whether the assumption of a single homogeneous underlying true effect is rejected statistically, a χ^2-test is used in meta-analysis. This Q-test is based on the test statistic

$$Q = \sum_{i=1}^{N} w_i (b_{di} - \bar{D}_{\bullet})^2 \ . \tag{3.4}$$

If the null hypothesis that all underlying effects are the same is rejected, the assumption of homogeneity of the observations is invalid. The observations are heterogeneous and reflect different underlying effects. As a result, the random-effects combined estimate is preferred.

The Q-test of sample homogeneity (see equation (3.4)) confirms that the assumption of a single underlying effect is rejected at standard significance levels. The outcome for the test (at χ^2_{286}) is highly significantly different from zero (p-value is 0.000). The random-effects estimate should be preferred and is significantly different from zero, as indicated by the t-statistic and the confidence interval.

The size of distance decay across the literature suggests that the effect is substantial, but not a natural constant. The differences across the estimates are for an important part due to unexplained heterogeneity. The remainder of this section explores whether part of this variation is due to a trend over time. Section 3.4 further explores heterogeneity by meta-

[6] A univariate regression of distance decay (positively defined) on the sampling standard error illustrates this relation. The coefficient on the standard error is –3.26 (robust t-statistic: 6.00), and the constant is estimated at 0.95 (28.60).

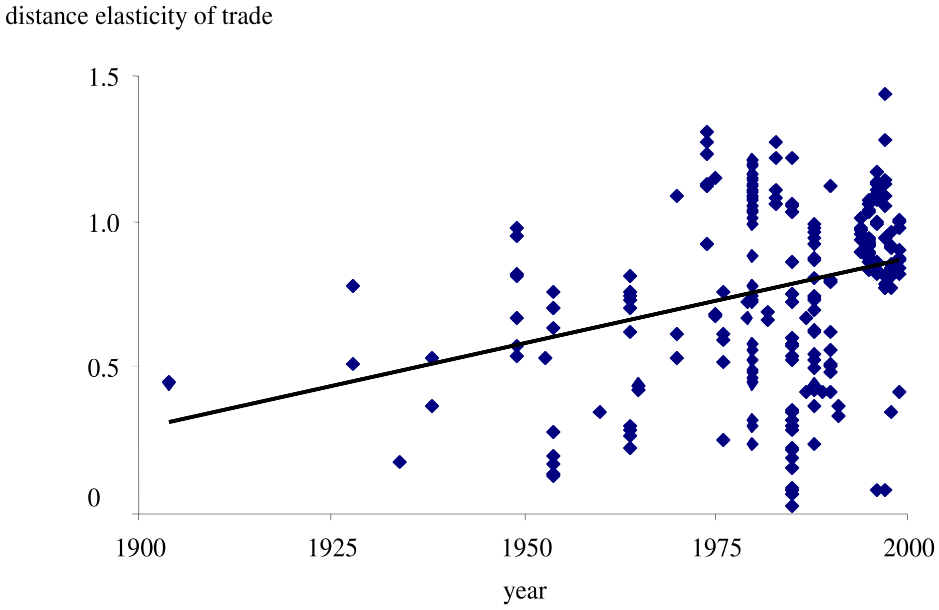
regression analysis to find out whether distance decay differs systematically according to the estimation and specification features of the primary studies.

3.3.3 Distance decay over time: 'death of distance' or still going strong?

The development over time of distance decay in trade is particularly interesting. Technological advances in transport and more recently in ICT, together with the advent of globalization, have led to the view that distance is rapidly becoming less important. This has given rise to metaphors, such as the 'global village' and the 'death of distance' to describe the economic development into the 21st century. The technological development in ICT and transport technologies over the course of the 20th century has been of major influence to the trends in international trade. Trade has grown more rapidly than world output, especially in the second half of the last century. The rising trend in trade is related to the fall in transport and communication costs, ongoing trade liberalization and increased similarity of income levels across countries, raising intra-industry trade (Baier and Bergstrand, 2001).

For our purpose, it is of interest how the decline in transport and other distance-related costs would affect the distance elasticity of trade. If distance becomes less costly for trade, one would expect that the distance decay parameter had declined in magnitude over time. However, various studies have reported a lack of a clear downward trend in the distance effect (e.g., Eichengreen and Irwin, 1998; Boisso and Ferrantino, 1997). Frankel (1997, p. 73) notes that "if anything, the trend seems to be upward". This has been identified as a puzzle, given the apparent fall in transport and communication costs (Leamer and Levinsohn, 1995; Wonnacott, 1998). Hence, the development of distance decay over time is one of the main questions to be answered. Figure 3.3 illustrates the trend in distance decay over time. The solid line reflects the time trend in a univariate regression of distance decay on time. This first exploration of the time trend confirms the findings reported elsewhere. The trend in distance decay appears to be upward.

Figure 3.3 Distance decay over time



3.4 Meta-regression analysis

Distance-decay estimates differ substantially across the literature. In the previous section, we have concluded that this variation cannot be explained by sampling error in the primary studies alone. Exploratory analysis suggests that the distance effect has not been constant over time, which offers a potential explanation for the variability of the observations. More generally, differences in the design of the primary studies may be accountable for differences in the resulting gravity-equation estimates of the distance effect. Relevant study characteristics include the estimation method used, the data type, the specification of the gravity equation in the primary study (e.g., the control variables included), as well as the time period and the geographical area considered. To assess whether these characteristics explain the variation in distance-decay estimates, multivariate meta-regression analysis has to be performed, including these characteristics as so-called moderator variables, a term used for regressor variables in meta-analysis.

3.4.1 Moderator variables

The moderator variables, based on various categories of study characteristics, are presented in Table 3.3 below. The expected effect of each moderator on the conditional underlying distance-decay parameter is indicated as well. We first briefly discuss the moderator variables, per category of study-characteristics, before we turn to the meta-regression results.

Estimation characteristics

The first moderator reflects whether the observation of distance decay has been estimated by an instrumental variable estimator. Although the distance variable itself is exogenous by construction and has not been instrumented in any of the primary studies, some studies instrument other explanatory variables in the gravity equation. Endogeneity bias may in general carry over to the parameters of exogenous regressors, such as distance. A dummy variable included in the meta-regression captures whether endogeneity bias affects the estimated distance parameter.

Another relevant estimation characteristic of primary studies for which we control is the use of random-effects panel-data estimators. If estimates of distance decay differ systematically for random-effects estimates, this points at possible inconsistency of the random-effects primary estimates, due to correlation between the error term and the regressors.

The final moderator for estimation characteristics indicates whether zero flows have been included in the sample in the primary estimation. Because of the double-logarithmic specification, the gravity equation cannot include these zero flows without some adaptations.[7] If an increase in bilateral distance leads to a higher probability of zero-valued trade, a sample selection bias may occur in case zero flows have not been taken into account.

[7] Chapter 5 of the thesis extensively discusses the estimation issues concerning zero flows.

Table 3.3 Summary of moderator variables in the meta-regression analysis.

Categories of moderator variables	Moderator variable name	Variable code	Description	Expected effect on absolute value of distance decay
Estimation characteristics	IV dummy	IV	1 if instrumental variables in primary gravity equation; 0 otherwise	+/-
	Random effects dummy	RE	1 if Random Effects panel estimate; 0 otherwise	+/-
	Zero flows dummy	Zeros	1 if zero flows included in sample; 0 otherwise	+
Data type	Panel data dummy	Panel	1 if panel data; 0 if cross-section data	?
Specification of trade	Export dummy	Exp	1 if export is dependent variable gravity equation; 0 otherwise	?
	Import dummy	Imp	1 if import is dependent variable gravity equation; 0 otherwise	?
	Transformed bilateral trade	Trans	1 if (1+total bilateral trade)* is dependent variable; 0 otherwise	?
Gravity model specification	Generalized gravity	GenGrav	1 if based on generalized gravity; 0 if traditional gravity equation	+/-
	Lagged-trade dummy	Lag	1 if lagged-trade regressor included; 0 otherwise	-
	Trade integration dummy	RIA	1 if FTA/regional group or import tariffs included; 0 otherwise	-
	Language/colonial links dummy	LanCol	1 if language/colonial ties included; 0 otherwise	+
	Contiguity dummy	Adj	1 if adjacency included; 0 otherwise	-
Temporal categorization	Great Depression dummy	DEP	1 if estimate applies to a year between 1930-1939	-
	Aftermath WW2 dummy	REC	1 if estimate applies to a year between 1946-1950	+
	Year†	t	0 (for 1904) – 95 (for 1999)	+/-
Geographic categorization	U.S. trade patterns dummy	US	1 if gravity model applied to US trade patterns	?
	European trade dummy	EUR	1 if gravity model applied to European trade patterns	?
	USSR trade dummy	USSR	1 if gravity model applied to intra-USSR trade before 1991	-

Notes:
†: For panel-data estimates, the year of observation is assigned to the mid year of the time period covered by the panel.
*: The base category, total bilateral trade, is defined as the sum of bilateral export and import between country *i* and *j*.

Data type and specification of trade

Panel-data estimates of distance decay may differ from cross-sectional estimates. We separately include moderators for random-effect panel estimators and fixed-effect panel estimators.[8] Thus, the moderator distinguishing panel data from cross-section data reflects a separate effect from pooling data. Bun and Klaassen (2003) argue that conventional panel studies do not control for all possible sources of trends in trade. This may result in omitted trend-variables bias, if some trending variables have been omitted from the model, or trends vary across countries and country-pairs. Cross-section estimates only reflect variation in trade across countries at a specific moment in time, and are not affected by omitted time-trend effects.

Differences in the choice of the dependent variable in the gravity equation, reflecting trade, may lead to different estimation results. According to Frankel (1997), bilateral imports and exports are sensitive to the effects of macroeconomic conditions (such as short-run deviations of the real exchange rate). Defining bilateral trade as the sum of export and import mitigates these effects and focuses more on the structural long-run determinants of the intensity of bilateral trade. Furthermore, the data on import are usually considered more reliable than export data. Whether these aspects systematically affect regression results is not clear beforehand.

Gravity model specification

The specification of the gravity model used for the primary estimation is a potentially important source of heterogeneity of the observations. Misspecification of the model primarily arises if relevant variables are omitted, which leads to omitted variables bias in the estimation of distance decay.

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[8] The latter is represented by the moderator that distinguishes generalized gravity equations from traditional gravity equations.

First, we consider the distinction between traditional gravity equations and generalized gravity equations (see also Chapter 2). The generalized gravity equation includes price level or average distance (remoteness) variables, or is estimated including country-specific effects. It has been argued by Bergstrand (1985; 1989), Oguledo and MacPhee (1994) and Anderson and Van Wincoop (2004) that traditional gravity equations suffer from omitted variables bias, because they do not include prices and remoteness. A dummy variable in the meta-regression model serves to capture whether the estimates from traditional and generalized gravity equations differ systematically.

The second moderator in this group considers the use of lagged trade as regressor in the primary estimation. Because distance is time-invariant, lagged trade and geographic distance are correlated. If lagged trade is relevant, the distance effect may capture hysteresis of trade. Because part of the effect of distance on trade operates through the lagged trade regressor(s), the distance decay parameter is expected to be lower in a lagged model.

Finally, we include moderators for several primary-study control variables that are likely to be correlated with distance: regional integration, preferential trade areas and bilateral import tariffs; linguistic and colonial links, and contiguity. If these variables are correlated with geographic distance, this leads to omitted variables bias in the distance effect estimates.

Temporal and geographic characteristics

We include two dummies for specific sub-periods in time. During the Great Depression, trade was determined more by protectionist policies than by natural barriers, such as distance. Therefore, we expect that distance had less effect on the patterns of trade. Conversely, the period directly after World War II was characterized by destructed infrastructure, especially hampering long-distance trade. This explains why we expect a higher distance effect in that period (see Eichengreen and Irwin, 1998).

We include a time trend to test whether the decline in transport and communication costs has resulted in a reduction of the distance elasticity of trade, or that the distance barrier has persisted over time. Given the contrast between some of the previous evidence and the common expectation of a 'death of distance', we leave the expected sign open, assuming that it could go either way.

Finally, we distinguish various spatial classifications of the observations. Distance decay in U.S. and European trade patterns may differ, both from each other and compared to average trade patterns across the world. The final regressor captures that trade between former member-states of the USSR was determined by planning rather than market mechanisms before 1991. As indicated by Djankov and Freund (2002), distance was less important for trade in that period.

3.4.2 Empirical results

Does the size of distance decay depend on the specific estimation method and specification chosen in the primary study? Is the rising trend of the distance effect over time robust for differences in other study characteristics? To answer these questions, we use meta-regression analysis to investigate whether the distance-effect observations are related to the characteristics identified in Table 3.3. We estimate the following meta-regression equation (see Table 3.3 for the variable codes used):

$$\begin{aligned} b_{di} &= \gamma_0 + \gamma_1 IV_i + \gamma_2 RE_i + \gamma_3 Zeros_i + \gamma_4 Panel_i + \gamma_5 Exp_i + \gamma_6 Imp_i \\ &+ \gamma_7 Trans_i + \gamma_8 GenGrav_i + \gamma_9 Lag_i + \gamma_{10} RIA_i + \gamma_{11} LanCol_i + \gamma_{12} Adj_i \\ &+ \gamma_{13} t_i + \gamma_{14} DEP_i + \gamma_{15} REC_i + \gamma_{16} US_i + \gamma_{17} EUR_i + \gamma_{18} USSR_i + \varepsilon_i \end{aligned} \tag{3.5}$$

The results of the regression are presented in Table 3.4. Several estimators have been used. Fixed-effects regression has been performed using either ordinary least squares (OLS), in specification (1), or weighted least squares (WLS), in specification (2). The former assumes equal weight for all observation, while WLS uses weights proportional to the precision of the primary estimates (i.e., the inverse of the primary-study sampling error). Random-effects regression, or the mixed-effect model, (specifications (3) to (5)) assumes that the underlying true distance effect varies randomly, and includes the estimated random-effects variance in the weights for the observations. We will focus on the results for the mixed-effect model (3).

Random-effects regression is usually preferred in meta-analysis, because it accounts for unexplained heterogeneity between observations.

Specifications (4) and (5) apply to a reduced sample, without the observations for geographic sub-groups (U.S., European and USSR trade patterns). These observations are very heterogeneous compared to the other estimates. Since dummies for each group may not capture all heterogeneity, these observations may lead to correlation between moderator variables and the unobserved random effect. This may lead to biased outcomes. For some moderator variables, the random-effects regression results for the reduced sample are more in line with the WLS results for the complete sample. Because WLS regression gives less weight to these groups of observations, which tend to be relatively imprecise, this suggests that these groups bias the results somewhat. Most meta-regression results, however, are comparable across random-effects and fixed-effects regression models. If the results differ qualitatively across specifications, we refer to them as ‘not robust’.

Estimation characteristics

The use of instrumental variable estimators in gravity equations appears to lead to higher estimated distance decay, correcting for endogeneity bias on the distance parameter. The effect is not statistically robust across meta-estimators, though. Separating the sources of endogeneity bias, for the reduced sample in specification (5), shows that the effect is usually positive, but most significant for lagged trade. This indicates that lagged trade may partly reflect omitted country-specific factors that cause bilateral trade patterns to persist over time, which leads to correlation between the error term and lagged trade in the primary estimation.

Random-effects panel estimators lead to significantly lower distance-decay estimates, which may reflect inconsistent results due to correlation between regressors and the random effect.

Table 3.4 Meta-regression of distance decay

	(1)	(2)	(3)	(4)	(5)
	OLS	WLS	Mixed Effect (ME)	ME: reduced sample†	ME: reduced sample†
IV dummy	0.075	0.064*	0.073	0.148***	
	(1.45)	(1.96)	(1.56)	(2.73)	
IV dummy (Lagged trade)					0.208**
					(2.46)
IV dummy (GDP)					0.079
					(0.64)
IV dummy (Exchange rate variability)					0.119
					(1.39)
Random effects dummy	–0.170***	–0.052	–0.159***	–0.143*	–0.142*
	(2.94)	(0.99)	(3.08)	(1.85)	(1.83)
Zero flows dummy	–0.006	0.058	–0.001	0.022	0.022
	(0.10)	(1.37)	(0.02)	(0.44)	(0.45)
Panel data dummy	0.302***	0.282***	0.302***	0.209***	0.206***
	(8.87)	(7.15)	(10.36)	(7.47)	(7.14)
Export dummy	0.115***	0.026	0.107***	–0.033	–0.035
	(3.53)	(0.81)	(3.86)	(1.18)	(1.23)
Import dummy	0.164**	–0.187*	0.161***	–0.236**	–0.231**
	(2.08)	(1.68)	(2.85)	(2.51)	(2.45)
Transformed bilateral trade	0.088	0.095	0.095	0.223***	0.205***
	(1.03)	(1.28)	(1.16)	(3.17)	(2.76)
Generalized gravity	–0.085	0.017	–0.102*	0.185**	0.183**
	(0.94)	(0.15)	(1.68)	(2.14)	(2.11)
Lagged-trade dummy	–0.423***	–0.485***	–0.432***	–0.482***	–0.485***
	(6.62)	(9.78)	(8.98)	(12.01)	(11.93)
Trade integration dummy	–0.044	–0.030	–0.044	–0.021	–0.017
	(1.12)	(0.87)	(1.28)	(0.61)	(0.49)
Language/colonial links dummy	0.120***	0.198***	0.132***	0.338***	0.339***
	(2.66)	(4.24)	(3.96)	(9.30)	(9.30)
Contiguity dummy	–0.194***	–0.324***	–0.210***	–0.487***	–0.490***
	(3.26)	(6.20)	(5.00)	(9.11)	(9.13)
Year	0.002	0.002	0.002**	0.003**	0.002**
	(1.54)	(1.25)	(2.22)	(2.43)	(2.00)
Great Depression dummy	–0.177**	–0.208***	–0.185*	–0.183*	–0.152
	(2.09)	(2.80)	(1.78)	(1.80)	(1.37)
Aftermath WW2 dummy	0.272***	0.294***	0.276***	0.309***	0.313***
	(5.94)	(5.84)	(3.86)	(5.15)	(5.18)
U.S. trade dummy	–0.481***	–0.371***	–0.453***		
	(5.98)	(3.74)	(7.80)		
European trade dummy	–0.735***	–0.753***	–0.735***		
	(16.13)	(22.46)	(18.52)		
USSR trade dummy	–0.564***	–0.562***	–0.562***		
	(12.71)	(16.19)	(6.62)		
Constant	0.713***	0.804***	0.725***	0.896***	0.915***
	(5.06)	(4.92)	(7.33)	(10.37)	(9.93)
Observations	287	287	287	214	214
Squared correlation observed and fitted value	0.75	0.67	0.75	0.79	0.79

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: distance elasticity (positively defined). The moderators are further explained in Table 3.3.
†: The reduced sample in specifications (4) and (5) excludes primary estimates for U.S., European and pre-reform USSR trade patterns (the constant term refers to 1928 as year 0).

Sample selection and censoring bias in primary estimates that do not account for zero flows does not affect the estimated distance decay. This provides support for the statement that zero flows do not influence the key results from gravity equations for aggregate trade much in practice.[9]

Data type and specification of trade

The results reveal a systematic difference between panel and cross-section estimates of distance decay. This suggests that omitted trend-variables bias is indeed important for panel-data gravity equations. In the gravity-model context, some country-specific variables may be missing from the model, as in the traditional gravity equation, or trend differently across countries or country-pairs. In principle, panel studies should include country-specific effects that are time-specific as well, but this is not common practice in the panel gravity-literature.[10,11] Because the panel studies impose constancy of distance decay over time, a trend in the distance effect itself, as suggested in our results, can be one of the sources of omitted country-pair specific trend effects. Standard panel-data estimates may pick up trends in trade that are actually caused by omitted trend variables.

[9] Chapter 5 confirms this conclusion after extensive analysis. However, we will see that, for disaggregate trade with many zero flows, this conclusion depends on the method used to account for zero flows.

[10] Bun and Klaassen (2003) are representative of a recent sub strand in the panel gravity literature. They also rightly refer to Baltagi et al. (2003), who allow for time-varying fixed effects as well. While Bun and Klaassen (2003) focus on trends in country-pair specific effects, Baltagi et al. (2003) focus on country-specific fixed effects. The latter approach extends the arguments of the generalized gravity model concerning country-specific omitted variables. Both are complementary, in tackling the problem of omitted trend-variables bias. Thus, the econometrically optimal flexible model should ideally include both extensions. Other contributions to the extension of panel gravity equations are Egger and Pfaffermayr (2005) and Egger (2004). An earlier reference on the importance of country-specific effects in panel gravity equations is Matyas (1997).

[11] Moreover, country-pair specific effects generally imply that the time-invariant distance parameter cannot be independently estimated anymore, because all bilateral effects are captured by the country-pair dummies. See Egger (2004), however, for methods to preserve time-invariant variables in a model with fixed effects. In our study sample, Raballand (2003) uses a two stage estimation to include bilateral fixed effects and independently estimate distance decay.

Differences in results according to the choice of dependent variable are not robust across our specifications. Only the moderator for transformed bilateral trade has a positive sign. This transformation expresses the dependent variable in gravity equations as $\ln(1+T_{ij})$, with T_{ij} equal to total bilateral trade. This is a method to enable zero flows to be included. However, this method is not robust to the choice of denomination of trade and appears to over-correct for selection effects (see Chapter 5).[12]

Gravity model specification

Differences in primary-estimation results for distance decay between traditional gravity equations and generalized gravity equations (which include either price levels, remoteness or country-specific fixed effects) are not robust in our meta-regression analysis. The results in the reduced sample point at higher estimates for generalized gravity. The negative finding in model (3) for the full sample may result from bias introduced by the geographical subgroups of observations. The alternative fixed-effects regression in specification (2), for the full sample, shows essentially no effect.

Gravity models including lagged trade yield substantially lower estimates of distance decay. The coefficients in a lagged model should be interpreted differently from those in a non-lagged model. As noted by Eichengreen and Irwin (1998), the parameters in such a gravity model become short-term effects (or direct impact effects) of the variable in question. For distance decay this means that when a country at some distance from an import partner opens up to trade, the direct effect of distance on their bilateral trade is measured by the distance decay elasticity, but the long-run equilibrium effect operates through lagged trade.

Regarding the primary control variables that tend to be correlated with physical distance, we find that gravity equations yield higher estimates for distance decay, if they control for common language and colonial history as trade-enhancing factors. This confirms ex-ante

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[12] Excluding these observations from the sample for meta-regression does not affect the results for other moderators. These results are not reported here, but available upon request.

expectations on omitted variable bias, because language and particularly colonial ties in general occur between distant nations, because of the historical features of colonial empires.

The effect of contiguity is also conform expectation. The contiguity variable corrects for measurement error in distance between bordering countries (which tends to be overestimated because of the practice to measure distance between country capitals), and reflects that bordering countries tend to be integrated more closely than non-bordering countries, all else equal. As bordering countries, on average, are closer in space than non-bordering countries, the effect of distance is overestimated if the model does not include a contiguity control.

In contrast, controlling for regional integration, preferential tariffs and free trade agreements does not appear to affect the estimated distance parameter in gravity equations.

Temporal and geographic characteristics

The meta-regression results provide support for a rising distance decay, after controlling for the effect of various estimation and specification characteristics that may cause estimates to differ across the literature. The time trend in the distance decay parameter is positive in all specifications, and significant in the mixed-effect models (3) to (5). The trend implies that, all else equal, the distance elasticity increases with roughly 0.02 over the course of a decade. In other words, the representative decay in trade as a result of a 1% increase in bilateral distance has increased by approximately 0.2 percentage points over the course of the 20th century, a proportional increase of about 25% compared to the pooled average distance decay of about 0.8 in our sample (see Table 3.2).

The estimates of distance decay apparently differ considerably across geographic area and time period. The results confirm the expectations for the time periods distinguished and for pre-reform trade in communist Russia. Apart from that, trade patterns for Europe and the U.S. are less sensitive to distance than average global trade patterns. Particularly the geographic classifications have large effects. The random-effects regressions in columns (4) and (5) exclude these spatial subgroups of primary estimates to check the robustness of the meta-regression results. Reassuringly, many results are comparable to the estimates for the full meta-sample.

After having discussed the results from the meta-regression analysis, we can draw some conclusions regarding the main questions that motivated this analysis. The next section discusses the implications of the meta-analysis for understanding the variation in the literature with respect to the reported estimates of the distance effect, and for assessing the size of the effect and its development over time.

3.4.3 Distance decay: size and development over time revisited

The empirical results of the meta-regression analysis indicate that the distance effect in trade is substantial and persistent over time, even if we take into account the variation according to study characteristics.

Focusing first on the magnitude of the effect, we can make the following inferences. The overall weighted average of distance decay, using the random-effect method, reveals that the elasticity of trade with respect is substantial. On average, trade falls by about 8% if distance increases by 10%. The meta-regression analysis investigated the sources of variation in the empirical estimates around this average effect. Conventional panel studies tend to lead to even larger estimates of distance decay, but may suffer from omitted trending variables bias (Bun and Klaassen, 2003). Including relevant regressors in the gravity equation that correlate with distance (notably, language and colonial links and adjacency) affects the size of distance decay, but these effects tend to cancel out against each other.

The results appear to suggest that European and U.S. trade patterns are much less sensitive to distance than average trade patterns. However, these effects seem to be too large. Because the geographic characteristics are not independently distributed from other characteristics, the heterogeneity of these observations may be problematic. Therefore, we estimated regression models excluding these observations from the sample as well, to check the robustness of our other estimation results. The size of distance decay is also affected by the specification choice whether or not to include lagged trade as a regressor. The short-run, direct impact effect of an increase in distance is substantially smaller than the long-run effect (about half the size of the long-run effect). This may reflect the importance of hysteresis in trade patterns (Eichengreen and Irwin, 1998). Historical ties tend to lock-in trade patterns, which may magnify the pure, direct negative impact of geographical distance. This finding suggests that incomplete information and search costs may lead to a lock-in of trade patterns, which provides support for the importance of international trade networks for understanding trade patterns (e.g., Rauch, 1999).

Transport costs do not suffice to explain the size of distance decay as found across the literature (Frankel, 1997; Grossman, 1998). Therefore, intangible barriers related to physical distance are important to explain the resistance to trade. This provides support for the relevance of informational and cultural familiarity aspects of physical distance, discussed in Chapter 2. A model of trade with incomplete information, in which familiarity declines rapidly with distance, where trade networks are important and tastes are culture-specific and home-biased might be relevant to understand the size of distance decay (Rauch, 1999; Grossman, 1998; Trefler, 1995).

Regarding the development of distance decay, the findings from our meta-regression analysis confirm that the effect of distance on trade has persisted over time, in spite of the decline in transport and communication costs. The results even indicate that distance has become more important for the patterns of trade. Various explanations for the lack of a downward trend in distance decay have been suggested.

First, the lack of a clear trend in the distance effect has been attributed to the possibility that technological progress in transportation and communication has been “distance neutral” (Buch et al., 2004; Anderson and Van Wincoop, 2003; Eichengreen and Irwin, 1998; Boisso and Ferrantino, 1997; Frankel, 1997). If transport costs fall proportionately irrespective of distance, trade would increase proportionately as well, leaving the distance parameter unaffected. However, Deardorff (1998) argues that a general reduction in transport costs will increase trade between distant countries and reduce trade between close countries. This implies that the distance elasticity of trade would fall if transport costs decline, all else equal. As shown by Grossman (1998), starting from the assumption that transport costs increase with distance, a proportionate fall in transport costs at all distances will lower the relative import (c.i.f.) price of a product for long distance trade relative to short distance trade. This is due to the fact that transport costs are higher for long-distance trade to begin with. When distance costs fall as a fraction of total costs, the rise in prices as a result of an increase in distance falls. The relative price of distant trade will fall vis-à-vis proximate trade, and distance decay in trade will become smaller as a result (cf. Rauch, 1999). Because trade at close distance becomes relatively more expensive after a general decline in transport costs, domestic trade will fall relative to international trade. Only this increase in openness as a result of falling distance-related trade costs is captured by the constant term in the gravity equation and leaves the marginal effect of distance (the distance effect) unchanged. Hence, if technological progress has reduced distance-sensitive trade costs over the past century, we would generally expect the distance decay parameter to decline over time.[13] The lack of such a trend has to be explained differently.

A possible explanation for the lack of a downward trend may be that progress in transportation technology has mostly benefited short-distance trade (Frankel, 1997). Regarding long-distance ocean shipping, the common wisdom of falling (relative) transportation costs has been challenged. Hummels (1999), for example, provides evidence that long-distance shipping has not become cheaper as a percentage of value added over the

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[13] As we noted in Chapter 2, section 2.4, the double logarithmic functional form of the relation between distance and bilateral trade in the gravity equation does not properly account for the relation between trade costs and distance. This specification would imply that trade approaches infinity when distance approaches zero, because prices would approach zero as well. Although this may in general lead us to question the standard specification of the gravity equation, we would argue that it does not affect the question at hand here. A correct specification would directly relate distance to trade costs, rather than to trade. As a result of this misspecification, we cannot clearly model the effect of a distance-neutral decline in transport costs within the standard gravity equation. However, the pattern in the data will reflect the true underlying relationship between distance and transport costs that we explained in the main text. All else equal, the marginal effect of distance on trade would fall, which would lead to a decline in distance decay over time, even if the standard gravity equation is sloppy in its specification of the relation between distance and trade.

past decades (see also Rietveld and Vickerman, 2004). If we compare this to alternative transport modes, the costs of rail transport, inland navigation and especially road and air transport have declined relatively over the past century (Rietveld and Vickerman, 2004). However, more recent improvements in ocean shipping such as the large-scale use of containers, may have been motivated mostly by an increase in the quality of transport (in terms of speed and reliability), rather than cheaper transport. Given the high willingness to pay for gains in time, total generalized costs of long-distance transport (including time-related economic depreciation and inventory costs) may have gone down after all. Moreover, the decline in narrowly defined real transport costs of ocean shipping has been very fast and keeping up with other transport modes before the 1960s. Thus, a relative increase in the costs of long-distance shipping does not seem to be a convincing explanation for the rise in distance decay during the whole period considered in the meta-analysis. Alternatively, distance decay in aggregate trade may be influenced by changes in the composition of trade over time. Because of growth in per capita incomes, a rising share of the value of world trade is composed of high value-to-weight products. This has been accompanied by a modal shift towards more expensive transport modes, such as air transport, which account for growing share of global trade, partly because the costs of transport have come down drastically for these transport modes. Because they are still relatively expensive, the modal shift may show as a rise in transport costs relative to the average costs of production. This might result in higher distance decay for overall trade.

Even if relative distance-related trade costs have gone down across the board, the marginal impact of distance on trade could still rise. Insights from new trade theory and new economic geography (NEG) theory illustrate that a fall in trade costs may promote agglomeration of economic activity. Depending on the starting point, falling trade costs may increase the profitability of clustering of economic activity in large markets. Because of the fall in international trade costs, the disadvantage of having to trade with the periphery declines relative to the advantage of operating in the core region (see, e.g., Fujita et al., 1999).[14] Because agglomeration implies that market size concentrates in the core region, most trade would occur between closely neighbouring core countries, and less trade will take place over large distances, effectively raising distance decay.[15] This process of agglomeration and regional concentration of trade flows may have been promoted by rising importance and proliferation of regional integration, which involves preferential trade areas and free trade blocs between countries in a regional setting.[16]

Furthermore, the decline of production costs and trade costs not related to distance (e.g., due to multilateral liberalization of trade) may have increased the relative importance of trade costs related to spatial barriers like geographic distance, compared to average marginal production costs (Estevadeordal et al., 2003; Anderson and Van Wincoop, 2004). This increases the relative price of long-distance trade. Again depending on the specific situation, agglomeration may occur in reaction to the rise in relative prices of distant trade, which

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[14] Agglomeration of industries subject to increasing returns to scale may come about through international factor mobility (e.g., Krugman, 1991), or intersectoral factor mobility within countries (e.g., Krugman and Venables, 1990). In fact, only the former approach classifies as NEG, while the latter is an extension of the basic new trade theory model (e.g., Krugman, 1980). The NEG distinguishes itself from new trade theory by the endogenization of market size (see Brakman et al., 2001). Although the new trade theory model with intersectoral factor mobility allows for both changes in production structure and market size (in terms of output value), which can culminate into (partial) agglomeration, these models have to presume ex-ante differences in market size (in terms of, e.g., population size) to begin with.

[15] Because agglomeration implies a restructuring of the spatial distribution of output, part of the increase in trade flows within the periphery can be explained by the increase in market size within the core group of countries, rather than by their spatial proximity. This implies that agglomeration not only affects distance decay. However, as a larger share of production is spatially concentrated within the core, the relative price of distant trade will rise. This leads to an increase in the marginal effect of distance on trade, that is: an increase in distance decay.

[16] As a qualification of the importance of NEG explanations of agglomeration for international trade, consider Davis and Weinstein (1996; 1999), who have argued that agglomeration effects are empirically more relevant for the distribution of production and trade between regions at the sub-national level. They find strong indications that economic geography effects (measured by ‘home market effects’) matter for various manufacturing sectors, comparing Japanese regions, but do not find statistically and economically significant effects, when comparing a sample of OECD countries. They argue that international barriers to trade and factor mobility remain too high for a significant role of economic geography in determining the disaggregate pattern of industrial production across countries.

causes the distance effect to increase over time, even though transport costs have gone down in absolute terms.[17] Furthermore, Frankel (1997) argues that the persistent distance effect indicates that intangible barriers associated with distance may be more important than transport costs to explain variation in trade. If the costs of informational and cultural barriers have not decreased relative to other trade costs, the distance effect remains large (Rauch, 1999; Frankel, 1997). The persistence of intangible distance-related trade barriers would reflect 'mental distance', in the terminology used by Klaassen et al. (1972). Even if communication costs fall, lack of information flows can persist, because of a historically and culturally determined lack of demand for these flows. The lack of familiarity may be sustained as well by high costs of frequent face-to-face contacts across large distances. All in all, the results suggest that distance has not become less important for trade patterns over time.

3.5 Conclusions

This chapter has illustrated that the empirical evidence about the effect of geographical distance on aggregate trade flows is heterogeneous. The distance effect on trade varies according to the estimation and specification characteristics of the primary studies. Meta-regression analysis shows that the variation in distance decay across the literature can be explained by estimation and specification features of the primary studies.

In short, when focusing on statistically significant effects, the following patterns have been identified. Panel studies generally produce a larger distance decay parameter. Models that include a lagged-trade regressor as explanatory variable result in lower distance elasticities. This reflects that the elasticity in these models is a short run, rather than a long-run effect. The omission of several bilateral variables from the gravity model leads to substantial omitted variables bias in the distance parameter. These variables are: common language or colonial ties and contiguity of countries. The use of generalized gravity equations, rather than a

[17] Both Albert de Vaal and Erik Verhoef suggested this interpretation.

standard gravity specification may lead to a larger estimated distance effect. The omission of zero flows from the regression sample does not systematically affect the estimated distance coefficient in gravity models of aggregate bilateral trade.

Most estimates of the trend in distance decay significantly indicate that the effect of distance on trade has increased over time. This suggests that distance has not become less important for trade patterns, despite the popular notions of the 'death of distance' and declining transport and communication costs. This finding supports the view that distance costs are multidimensional and that intangible barriers remain important. These will be further addressed in Chapters 4–6.

Appendix 3A List of case studies included

Abraham, F., E. Buyst and S. Geyssens (1997): Trade Integration in the Twentieth Century: What Does Belgian History Tell Us?, *Weltwirtschaftliches Archiv*, 133, pp. 708–736.

Anderson, J.E. and D. Marcouiller (2002): Insecurity and the pattern of trade: an empirical investigation, *Review of Economics and Statistics*, 84, pp. 342–352.

Bougheas, S., P.O. Demetriades and E.L.W. Morgenroth (1999): Infrastructure, Transport Costs and Trade, *Journal of International Economics.February*, 47, pp. 169–89.

Dell'Ariccia, G. (1999): Exchange Rate Fluctuations and Trade Flows: Evidence from the European Union, *IMF Staff Papers*, 46, pp. 315–334.

Djankov, S. and C. Freund (2002): New Borders: Evidence from the Former Soviet Union, *Weltwirtschaftliches Archiv/Review of World Economics*, 138, pp. 493–508.

Eichengreen, B. and D.A. Irwin (1998): The Role of History in Bilateral Trade Flows, in: J.A. Frankel (ed.), *The Regionalization of the World Economy*, pp. 33–57, Chicago and London: The University of Chicago Press.

Endoh, M. (1999): The Transition of Postwar Asia-Pacific Trade Relations, *Journal of Asian Economics.Winter*, 10, pp. 571–89.

Frankel, J., E. Stein and S.J. Wei (1995): Trading blocs and the Americas: The Natural, the Unnatural, and the Super-Natural, *Journal of Development Economics*, 47, pp. 61–95.

Frankel, J. and A. Rose (2002): An Estimate of the Effect of Common Currencies on Trade and Income, *Quarterly Journal of Economics*, 117, pp. 437–466.

Freund, C.L. and D. Weinhold (2000): On the Effect of the Internet on International Trade, *Board of Governors of the Federal Reserve System: International Finance Discussion Papers*, no. 693, Washington D.C.

Hejazi, W. and A.E. Safarian (2001): The Complementarity between U.S. Foreign Direct Investment Stock and Trade, *Atlantic Economic Journal.December*, 29, pp. 420–37.

Jakab, Z.M., M.A. Kovacs and A. Oszlay (2001): How Far Has Trade Integration Advanced?: An Analysis of the Actual and Potential Trade of Three Central and Eastern European Countries, *Journal of Comparative Economics*, 29, pp. 276–92.

Nilsson, L. (2002): Trading Relations: Is the Roadmap from Lome to Cotonou Correct?, *Applied Economics*, 34, pp. 439–52.

Oguledo, V.I. and C.R. MacPhee (1994): Gravity Models: A Reformulation and an Application to Discriminatory Trade Arrangements, *Applied Economics*, 26, pp. 107–120.

Raballand, G. (2003): Determinants of the Negative Impact of Being Landlocked on Trade: An Empirical Investigation through the Central Asian Case, *Comparative Economic Studies*, 45, pp. 520–536.

Rose, A.K. (2000): One Money, One Market: The Effect of Common Currencies on Trade, *Economic Policy*, 15, pp. 8–45.

Rose, A.K. (2004): Do We Really Know That the WTO Increases Trade?, *American Economic Review*, 94, pp. 98–114.

van Bergeijk, P.A.G. and H. Oldersma (1990): Detente, Market-Oriented Reform and German Unification: Potential Consequences for the World Trade System, *Kyklos*, 43, pp. 599–609.

Wall, H.J. (1999): Using the Gravity Model to Estimate the Costs of Protection, *Federal Reserve Bank of St.Louis Review*, 81, pp. 33–40.

Appendix 3B Methods of meta-analysis

In this appendix, the meta-analytical tools used in the main text are described in more detail. First, we discuss the methods for pooling effect sizes in order to derive a combined estimate of the distance effect. In the second section, we focus on meta-regression techniques to study the sources of variation in underlying effects.

3B.1 Combining effect sizes

Under the fixed-effect assumption, the combined average is a consistent estimate of the unique true underlying distance effect (β_d). All estimation error is caused by the sampling variance in the primary studies. The combined estimate of a random-effects model estimates the underlying mean distance decay parameter of the distribution of underlying distance effect sizes ($\overline{\beta}_d$). The estimation variance of the pooled average now reflects both sampling error within the primary studies and heterogeneity between the primary estimates, captured by the random variation of underlying effect sizes. For a consistent random-effects estimate, an important assumption to be made is that the primary-study observations are a random sample of the population of all potential primary estimates. This explains why the study sampling has to be constructed carefully.

The fixed-effect model integrates the sampled effect-size estimates into a pooled estimate of distance decay ($\overline{D}_{\bullet}$) (see, e.g., Sutton et al., 2000):

$$\overline{D}_{\bullet} = \frac{\sum_{i=1}^{N} w_i b_{di}}{\sum_{i=1}^{N} w_i}, \tag{3.6}$$

in which b_{di} stands for primary-study estimate i of the distance-decay elasticity in bilateral trade. The observations are given weights proportional to their precision. The weight (w_i) attached to the observation is usually given by the reciprocal of the estimated sampling variance of the primary estimate of the distance parameter:

$$w_i = \frac{1}{s_{di}^2}. \tag{3.7}$$

Under the assumption of independence of the primary estimates, these weights ensure that the variance of the pooled estimate is minimized and smaller than the minimum primary-estimate sampling variance. The variance of the fixed-effect combined estimate of distance decay is given by equation (3.8):

$$\mathrm{Var}(\bar{D}_{\bullet}) = \frac{1}{\sum_{i=1}^{N} w_i}. \tag{3.8}$$

The random-effects model assumes that the primary estimates are heterogeneous, because they reflect different randomly varying underlying population effect sizes. Consequently, the random-effects combined distance effect estimates the mean of the underlying distance-decay distribution. The random-effects model yields equations that are similar to equations (3.6) – (3.8), in which we only need to adjust the weights for the individual observations. Because the underlying effect sizes estimated by the primary-study observations are assumed to vary at random, the variance of each observation consists of the sampling variance of the primary estimate and the random-effects variance between underlying effect sizes. The primary estimates are thus modelled as follows:

$$\begin{aligned}
&b_{di} = \beta_{di} + \varepsilon_i \\
&\beta_{di} = \bar{\beta}_d + \mu_i \\
&\text{with:} \\
&\varepsilon_i \sim N(0, \sigma_{di}^2) \\
&\mu_i \sim N(0, \tau_\beta^2) \\
&\varepsilon_i \text{ and } \mu_i \text{ independent } \forall i \\
&\mathrm{var}(b_{di}) = \tau_\beta^2 + \sigma_{di}^2
\end{aligned} \quad , \tag{3.9}$$

where β_{di} is the underlying effect size of estimate i, σ_{di}^2 is the sampling variance of the i^{th} observation and τ_β^2 the between-estimate variance of underlying effect sizes.

The weight that should be substituted in equations (3.6) and (3.8) for each primary estimate, in order to estimate the random-effects pooled average and its estimated variance includes the estimate of random-effects variance in the underlying effects, $\hat{\tau}_\beta^2$ (see Sutton et al., 2000):

$$w_i^* = \frac{1}{\hat{\tau}_\beta^2 + s_{di}^2}. \tag{3.10}$$

Because of the contribution of the random-effects variance to the variation in the observations, the confidence interval for the random-effect overall estimate will be larger than for the fixed effect. Substituting equation (3.10) into equations (3.6) and (3.8), we can compute the random-effects pooled estimate for $\overline{\beta}_d$, $\overline{D}_\bullet^{RND}$, and its estimated variance, $\mathrm{Var}\left(\overline{D}_\bullet^{RND}\right)$. The estimation procedure requires that we also estimate the random-effects variance (τ_β^2), which enters into the weights for the observations, from the same data (see Sutton et al., 2000, for further details).[18]

The fixed effect and random-effects methods to combine observations into a pooled estimate differ in their assumption about the homogeneity of primary estimates. To assess which model to use, a test statistic known as the *Q*-statistic is frequently used in meta-analysis. This test statistic computes the weighted sum of squared deviations of primary estimates from the overall fixed effect average given in equation (3.6), with individual weights given by equation (3.7):

$$Q = \sum_{i=1}^{N} w_i (b_{di} - \overline{D}_\bullet)^2. \tag{3.11}$$

The *Q*-statistic resembles a variance formula, and is (approximately) $\chi^2(N-1)$ distributed under the null hypothesis that the true underlying treatment effect is the same for all *N* observations ($H_0 : \beta_{d1} = \beta_{d2} = \beta_{d3} ... = \beta_{dN} = \beta_d$). The outcome of the statistic can be compared to the critical value at standard significance levels. If the null hypothesis is rejected,

[18] For the software package Stata™ 7.0, a user-written routine exists to estimate the random-effects pooled estimate and variance using the weighted method (the fixed-effect estimate is routinely computed as well). This routine, `meta`, can be downloaded from the Stata website.

this indicates that the observations are heterogeneous and the random-effects model is preferred.

3B.2 Regression models in meta-analysis

Although the random-effects combined estimate corrects for heterogeneity between the observations, it does not exploit the variation between estimates analytically. Meta-regression methods have been designed to investigate whether the observations of distance decay differ systematically according to their characteristics. Analogous to the methods for combining effects, regression models for meta-analysis include fixed-effects regression and random-effects regression.[19] The meta-regression model (fixed-effects regression) assumes that the conditional underlying effect sizes ($\beta_{d1}, \beta_{d2}, ..., \beta_{dN}$) for the N estimates ($b_{d1}, b_{d2}, ..., b_{dN}$) differ systematically according to a fixed linear relationship with k moderator variables[20] ($x_1, x_2, ..., x_k$) that reflect various characteristics of the primary estimate. This leads to the following specification of the meta-regression model:

$$\begin{aligned} & b_{di} = \beta_{di} + \varepsilon_i \\ & \text{with:} \\ & \beta_{di} = \gamma_0 + \gamma_1 x_{1i} + ... + \gamma_k x_{ki} \\ & \varepsilon_i \sim N(0, \sigma_{di}^2) \\ & (\varepsilon_1 ... \varepsilon_N) \text{ independent} \\ & E(b_{di} \mid x_{1i} ... x_{ki}) = \beta_{di} \\ & \text{var}(b_{di} \mid x_{1i} ... x_{ki}) = \sigma_{di}^2 \end{aligned} \quad , \qquad (3.12)$$

[19] This terminology in meta-analysis is unrelated to the use of fixed and random effects in conventional panel-data regression techniques. In meta-analysis, the term 'fixed effect' is used when the underlying population effect size is deterministic, whereas 'random effect' refers to randomly varying underlying effect sizes. Both terms refer to the underlying effect to be estimated in the meta-analysis.

[20] In meta-analysis, the term 'moderator variables' is generally used to refer to the regressors.

where ($\gamma_1, \gamma_2, ..., \gamma_k$) are the regression coefficients to be estimated in the model. Note that all variation in the underlying effect is due to the moderator variables, hence not random. This explains why the model in equation (3.12) is called fixed-effects regression.

A few technical remarks have to be made regarding the estimation of the regression coefficients in the meta-regression model. As for combining effect sizes, all primary estimates have to be weighted by the inverse of their sampling variance. In practice, fixed-effects regression is equivalent to estimating equation (3.12) by weighted least squares (WLS), using the inverse of the sampling standard error of the observations (s_{di}) as weights. However, the reported standard errors for the coefficients ($\gamma_1, \gamma_2, ..., \gamma_k$) of the WLS regression have to be adjusted, because the WLS model is slightly different from the meta-regression model (see Sutton et al., 2000, Chapter 6; Hedges, 1994). The correct standard errors for the estimated regression coefficients in the meta-regression model are given by:

$$\tilde{s}_{\gamma_k} = s_{\gamma_k} / s_\varepsilon \,, \tag{3.13}$$

where s_ε is the standard error of the regression equation specified in equation (3.12).

The mixed-effect model (random-effects regression) assumes that the conditional underlying effect sizes ($\beta_{d1}, \beta_{d2}, ..., \beta_{dN}$) for the N estimates ($b_{d1}, b_{d2}, ..., b_{dN}$) differ both systematically according to various characteristics of the primary estimate and randomly according to a fixed distribution:

$$\begin{aligned}
& b_{di} = \overline{\beta}_{di} + \mu_i + \varepsilon_i \\
& \overline{\beta}_{di} = \gamma_0 + \gamma_1 x_{1i} + ... + \gamma_k x_{ki} \\
& \text{with:} \\
& \varepsilon_i \sim N(0, \sigma_{di}^2) \\
& \mu_i \sim N(0, \tau_\beta^2) \\
& (\varepsilon_1 ... \varepsilon_N), (\mu_1 ... \mu_N) \text{ independent} \\
& E\left(b_{di} \mid x_{1i} ... x_{ki}\right) = \overline{\beta}_{di} \\
& \operatorname{var}\left(b_{di} \mid x_{1i} ... x_{ki}\right) = \tau_\beta^2 + \sigma_{di}^2
\end{aligned} \tag{3.14}$$

As before, the optimal weight for each observation is given by the reciprocal of its estimated variance:

$$w_i^* = \frac{1}{\hat{\tau}_\beta^2 + s_{di}^2} \tag{3.15}$$

The estimated sampling variance is available for each observation, from the primary studies. However, the random-effects variance has to be estimated in the random-effects regression. Usually, the regression parameters ($\gamma_1, \gamma_2, ..., \gamma_k$) and τ_β^2 are estimated by restricted ML, which accounts for the fact that both the regression parameters and the random-effects variance have to be computed from the same data.[21] The literature on meta-analytical methods generally argues that the mixed-effects model is preferable in meta-regression analysis, because the moderator variables cannot be expected to account for all sources of heterogeneity between the observations.

[21] Again, a user-written Stata™ 7.0 routine, `metareg`, will be used to estimate the random-effects regressions presented in section 3.5.

Part II

Institutions, Culture and Trade: Empirical Analysis

Chapter 4

Institutional Determinants of Bilateral Trade[1]

4.1 Introduction

As discussed in Chapter 2, recent research in international economics points at the likely relevance of barriers to trade other than transport costs, tariffs and quotas. These intangible barriers to trade are partly related to variation in the effectiveness of the formal institutional setting across countries. Because international transactions involve multiple governance systems, the effectiveness of domestic institutions in securing and enforcing property rights in economic exchange is an important determinant of trade costs. Furthermore, formal rules affect informal norms of behaviour and inter-personal trust, which influence the mores and conventions of doing business. These, in turn, may also impact on risk perceptions and preferences in international transactions. This chapter therefore investigates the hypothesis that institutions matter for international trade.

In order to identify the effects of institutions on bilateral trade, we estimate various specifications of gravity equations in the remainder of this chapter. In general, the gravity model considers trade between a pair of countries as an increasing function of their national incomes and a decreasing function of their geographical distance. Other variables that relate

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[1] This chapter is based on De Groot et al. (2004), and De Groot et al. (2005a).

to both countries, or either of the two countries separately, often enter into the equation as well, such as income per capita, common language, contiguity, etc. (see Chapter 2).

A number of recent studies have considered the impact of institutions on trade in a gravity model context (e.g., Anderson and Marcouiller, 2002; Koukhartchouk and Maurel, 2003). Anderson and Marcouiller have published several articles that extend institutional analysis of the economy explicitly to the field of international trade (e.g., Anderson and Marcouiller, 2002 and 2005). They combine the analysis of the effects of institutions in a theoretical model with empirical estimates of the impact of institutional effectiveness on trade.[2] Koukhartchouk and Maurel (2003) analyse the effects of joining international institutions such as the WTO and the EU on trade patterns. They introduce variables reflecting institutional quality into the analysis of potential trade effects for Central and Eastern European countries. Other recent studies on the effect of institutions on trade include Redding and Venables (2003), Jansen and Nordas (2004) and WTO (2004) (see Chapter 2).[3]

This chapter intends to contribute to the growing empirical literature in two ways. First, we have used the most recent and comprehensive data-set on the quality of governance available. This database was constructed for the World Bank by Kaufmann et al. (2003). Indicators from 25 different sources, constructed by 18 organisations have been combined, including the sources used by Anderson and Marcouiller (2002) (World Economic Forum's Global Competitiveness Report) and Koukhartchouk and Maurel (2003) (Heritage Foundation, Economic Freedom Index). Second, we analyse not only the effect of institutional quality on trade, but also the effect of bilateral differences in governance quality. In this way, we capture both the country-specific effect of good governance on trade, and the bilateral influence of institutional distance on patterns of trade. The expectation is that institutional proximity

[2] Also see Dixit (2004), for an alternative theoretical approach on the relation between formal and informal governance and (international) trade.

[3] Anderson (2001) and Den Butter and Mosch (2002) are examples in the literature that focus on the effects of informal institutions on trade.

results in similar, hence familiar, informal business procedures, which reduces transaction costs.

We proceed as follows. Section 4.2 discusses the measures of institutional quality that we have used in the analysis. In sections 4.3 and 4.4, we present and discuss the regression results for alternative specifications of a basic and extended gravity model, respectively. Section 4.5 concludes.

4.2 Data description and model setup

In the empirical analysis that follows, we make use of both country-specific and bilateral data from various sources. Gross domestic product for exporting and importing countries are examples of country-specific variables that we include in the analysis. Geographical distance, adjacency, main language and religion, amongst others, are examples of other characteristics that we take into account for each pair of countries. We focus on trade patterns in 1999, for a set of 127 countries, listed in the Data Appendix at the end of the thesis. We use bilateral exports as dependent variable, such that each country pair yields two observations, with each country either as exporter or importer. Since these variables are more or less standard in the literature, we do not extensively discuss them here (see the Data Appendix).

Since the main emphasis in this chapter is on the effects of institutions, we take a closer look at the institutional variables. We have used the database constructed by Kaufmann et al. (2003). They have constructed six indicators of perceived institutional quality. Each indicator captures some related aspects of the quality of governance. They either reflect the political process, the quality of the state apparatus and its policies, or the success of governance. We discuss these indicators in turn.

1. 'Voice and Accountability' reflects the extent to which citizens can participate in selecting government and hold her accountable for the actions taken. This score includes various characteristics of the political process as well as assessments of the independence of the

media. It reflects whether citizens and business can prevent arbitrariness in the behaviour of government and enforce good governance when needed.

2. ‘Political Stability’ refers to the perceived likelihood of the government being destabilised or overthrown by unconstitutional interference or excesses of violence against persons and possessions. These factors are highly detrimental for the continuity of policy and the stability of the economic environment.
3. ‘Government Effectiveness’ is a measure for the quality of government inputs. It represents, amongst others, the perceived quality and independence of the bureaucracy. This indicates the ability of government to formulate and implement good policies.
4. ‘Regulatory Quality’ is directly focused on the quality of implemented policies. It includes the perceived incidence of policies that inhibit the market mechanism, and excessive regulation of foreign trade and business development and as such closely reflects the transaction costs that result from policy intrusion by the state in private trade.
5. ‘Rule of Law’ indicates the quality of the legal system. It indicates society’s perceived success in upholding fair and predictable rules for social and economic interaction. Essentially, it focuses on the quality of the legal system and the enforceability of contracts.
6. ‘Control of Corruption’ represents the extent of ‘lawless’ or unfair behaviour in public-private interactions. It complements regulatory quality and rule of law indicators, pointing at the impact of bad governance on economic interaction. Corruption, like regulatory intrusion, affects transaction costs by adding a ‘third-party’ involvement to private transaction. An added component of corruption to trading costs is its arbitrary, uncertain nature.

Table 4.1 below illustrates the data on institutional quality. It presents the sample means and standard deviations for each of these indicators, together with some tentative illustration of the corresponding cross-country differences in institutional quality.

Table 4.1 Some data on governance as illustration: countries at various levels of quality

Governance Quality	Voice & Account.	Polit. Stab.	Governm. Effect.	Regul. Quality	Rule of Law	Contr. of Corruption
One s.d. above mean	Spain	France	Hong Kong	Uruguay	Spain	Slovenia
Mean Governance	Slovenia	Morocco	China	Brunei	Tanzania	Jordan
One s.d. below mean	Azerbaijan	Benin	Yemen	Burundi	Azerbaijan	Tanzania
Mean (s.d.)	0.07 (0.94)	0.16 (0.90)	0.22 (0.99)	0.29 (0.81)	0.23 (0.98)	0.18 (1.07)

Notes: All indicator scores have been scaled from about –2.5 to +2.5. The selected countries have a minimum distance to the mean and the score of one standard deviation above and below average, respectively. Source: Kaufmann et al. (2002).

All aspects of governance are highly positively correlated. Thus, adding the separate indicators at once results in serious problems of multicollinearity. An investigation of homogeneity using Cronbach’s alpha suggests that all indicators reflect a single latent variable, which we could label ‘overall institutional quality’.[4] Therefore, the analysis in this chapter is based on a composite indicator of institutional quality, reflecting the overall quality of governance in a country. The simple arithmetic average of the scores across all indicators serves as our composite indicator of institutional quality. We have used the indicator scores on institutional quality for 1998.

[4] Cronbach’s alpha (α) measures how well a set of variables reflects a single underlying latent variable; this reflects the internal consistency (or validity) of an overall scale based on the set of variables. The coefficient was originally developed to assess the internal consistency of a set of questions (items), as on a survey form (Cronbach, 1951). We use it to assess whether we can combine the six indicators of institutions into a single overall indicator. The calculation of α is based on the average correlation among pairs of the indicators. Cronbach’s alpha varies between 0 and 1 (for non-negatively correlated variables). If the indicators are perfectly correlated, then α=1; if they are completely unrelated, α=0. If α is high (close to 1), this indicates a high degree of internal consistency. Generally, a value of 0.8 or above indicates sufficient internal consistency. The α score for the six indicators of institutions is 0.96. Thus, they reflect the same underlying characteristic and can be combined into a single scale. In this way, we can use all information about governance in the regression analysis without running into problems of multicollinearity, which occur when including the individual indicators together.

To capture heterogeneity in institutional quality, we have constructed a set of dummy variables. If the absolute difference in institutional effectiveness between two countries in a country-pair exceeds (is below) a specified fraction of the sample standard deviation of overall institutional quality, the countries are viewed as heterogeneous (homogeneous) in terms of the quality of governance. In such a case, the country-pair scores a value of one (zero) on the governance heterogeneity dummy. The estimated effect of institutional heterogeneity on trade, measured in this way as a discrete impact, is clear and concise in its interpretation. However, the results may depend on the demarcation value of institutional quality difference above which we classify two countries as heterogeneous. Therefore, we address the results for three different heterogeneity criteria: differences larger than one standard deviation of institutional quality, two standard deviations, or three standard deviations. Alternatively, we have specified a non-linear function of the difference in institutional quality to reflect institutional distance on a continuous scale. Institutional distance is thus measured as the average of variance-weighted squared bilateral differences on the six separate governance indicators:

$$ID_{ij} = \frac{1}{6}\sum_{k=1}^{6}\left(I_{ki} - I_{kj}\right)^2 \Big/ V_k \,, \tag{4.1}$$

where I_{ki} indicates the score on institutional indicator k for country i and V_k indicates the variance of this dimension across all countries. This distance measure is based on Kogut and Singh (1988); the higher its value, the higher overall institutional distance between a pair of countries i and j.

The extended gravity equation that we focus on below looks as follows:

$$\begin{aligned}\ln(T_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(y_i) + \beta_4 \ln(y_j) + \beta_5 \ln(D_{ij}) + \beta_6 Adj_{ij} \\ + \beta_7 RIA_{ij} + \beta_8 Lan_{ij} + \beta_9 Col_{ij} + \beta_{10} Rel_{ij} + \beta_{11} IQ_i + \beta_{12} IQ_j + \beta_{13} ID_{ij} + \varepsilon_{ij}\end{aligned}, \tag{4.2}$$

where i and j denote the exporting and importing country. The dependent variable T_{ij} is aggregate merchandise exports from i to j for 1999. The independent variables are: national income (Y) and income per capita (y), both in US$, the distance between i and j in kilometres (D_{ij}), dummies reflecting whether i and j share: a border (Adj_{ij}), membership in a regional integration agreement[5] (RIA_{ij}), their primary language (Lan_{ij}), their main religion (Rel_{ij}), and whether they were part of a common colonial empire (Col_{ij}). See the Data Appendix for sources and further description on these variables. The variables of particular interest in this chapter are, respectively, the level of subjective institutional quality (IQ), and the different indicators of institutional distance (ID_{ij}). The last term is the stochastic error term, which captures all other (omitted) effects on trade and is assumed to be well-behaved. The gravity model estimates are acquired using OLS.

4.3 Basic results

Before investigating the effects of institutions, we first discuss a set of specifications of the gravity equation that take into account standard variables often applied in the literature. The results are contained in Table 4.2. In the first specification, we regress bilateral exports on the levels of gross domestic product in the exporting and importing country and their geographic distance. This specification reflects the basic gravity model (see Chapter 2). It corresponds readily to new trade theory models, for example, in which trade is positively related to market size (e.g., Helpman and Krugman, 1985) and negatively to distance (e.g., Krugman, 1980). Distance serves as a proxy for the size of transportation costs and other distance-related trade costs (see, e.g., Fujita et al., 1999). In accordance with the gravity model literature on bilateral trade, we find that GDP positively and significantly affects trade. This confirms theoretical expectations. Since we focus on exports rather than total bilateral trade, we can also examine whether the effect of GDP on trade differs between the country of origin and the country of destination of trade flows. The results indicate that export supply is income elastic: a 1%

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[5] Membership in a common regional integration agreement is a proxy for formal policy barriers to trade. This variable includes both formal free trade areas (FTAs, such as NAFTA and EU) and preferential trade agreements (PTAs), and less formal integration agreements such as APEC.

increase in exporter GDP raises bilateral trade on average by about 1.2%, while trade is unit elastic with respect to importer GDP.

Table 4.2 Standard gravity equations

	Specification (1)	Specification (2)	Specification (3)	Specification (4) †
Log GDP exporter	1.23***	1.19***	1.18***	
	(134.98)	(100.28)	(99.00)	
Log GDP importer	1.01***	0.98***	0.97***	
	(110.15)	(76.81)	(75.46)	
Log Distance	–1.26***	–1.25***	–1.10***	–1.31***
	(58.58)	(57.30)	(48.35)	(41.68)
Log GDP/cap exp.		0.07***	0.10***	
		(4.61)	(6.39)	
Log GDP/cap imp.		0.04**	0.07***	
		(2.52)	(4.07)	
Border Dummy			1.01***	0.87***
			(7.80)	(6.70)
Trade area Dummy			0.61***	0.24***
			(8.49)	(3.11)
Language Dummy			0.40***	0.49***
			(4.36)	(5.21)
Colonial Dummy			0.81***	0.72***
			(10.35)	(8.73)
Religion Dummy			0.12**	0.35***
			(2.53)	(6.99)
Constant	–35.52***	–35.13***	–36.39***	10.98***
	(91.86)	(89.36)	(93.70)	(27.59)
Observations	13682	13682	13682	13682
Adjusted R-squared	0.67	0.67	0.68	0.74
F-statistic	10302.91	6213.23	3170.87	173.79

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log aggregate bilateral exports.
†: Specification (4) is estimated including country-specific effects for the exporting and importing countries.

Distance negatively affects the intensity of trade. According to our estimates, a 1% increase in bilateral distance reduces trade more than proportionately.[6] The effect of distance is highly significant statistically as well. The result supports the view that trade barriers are relevant for

[6] For comparison, the distance elasticity of trade in our estimations is consistently higher than the combined (average) estimate across the literature presented in Chapter 3 (about –0.8). Note, however, that our estimates remain within the typical margin of variation in estimated distance decay across the literature. This margin of variation provided the motivation for investigating the determinants of heterogeneity in distance decay, using meta-regression analysis. Characterizing our typical estimates within the setting of meta-regression analysis applied in Chapter 3, for example, would take into account that the estimates are for 1999, include language and colonial history controls, some of them use fixed effects, etc.

explaining the patterns of trade. The importance of variation in GDP and bilateral distance in accounting for the variation in trade is illustrated by the fact that the basic gravity equation explains more than 65% of the variation in trade patterns.

Standard gravity models also control for other country-specific and bilateral characteristics that may affect trade. The second specification included in Table 4.2 allows for an effect of the level of development on trade. Trade is estimated to increase with the level of income per capita in both countries. These coefficients are statistically significant at the 1% and 5% level, respectively. This finding has also been reported frequently in other gravity studies (see Frankel, 1997; 1998), but is not undisputed. Trade theories do not provide a clear explanation for the positive effect of per capita income levels. As it is, the estimates confirm the observation by Deardorff (1998, p. 16) that "high-income countries trade disproportionately more (…) with all trading partners and not just among themselves, while low-income countries trade less". Adding income per capita to the gravity equation decreases the coefficients for the GDP variables slightly. Appendix 4A provides more discussion of the possible role for GDP per capita in the gravity equation, and its interpretation. For example, we examine how GDP per capita can be consistently included in the gravity equation for aggregate trade in a different way, to assess the relevance of the Linder hypothesis for bilateral trade. This hypothesis states that countries with similar per capita incomes trade more with each other, because of similar preferences. Note that the research findings of including GDP per capita levels in the gravity model only partly reflect this pattern. Wealthy countries trade more among each other, but poor countries trade less among each other, all else equal.

The third specification extends the model with several variables that have proven to be effective controls for shared historical, political and cultural background (see Chapter 2, and, e.g., Frankel, 1997). Measurement error in the distance variable, as well as the effect of historical relations between adjacent countries, are captured by a dummy for common border. We control for the effect of economic integration using a dummy variable for common membership in regional trading blocs. Furthermore, we include dummy variables to indicate the presence of a common primary official language, common dominant religion and common colonial history. The results show that all variables have the expected positive sign as is often reported in the literature, and are significant at the 5% level at least.[7]

The coefficients on GDP and GDP per capita are quite robust to these extensions. The estimated impact of distance on trade (positively defined) declines somewhat. Some of the trade facilitating relations represented in the bilateral dummy variables more or less cluster in space, which may drive the downward effect on the size of distance decay (see also Chapter 3). Thus, adding these variables corrects for an upward omitted variables bias in the estimated impact of distance on trade.

We may still wonder whether the coefficients on the bilateral dummies themselves suffer from the effects of omitted country-specific effects. The results for a regression equation that includes country-specific dummies for each country, both as exporter and importer, are presented in the last column of Table 4.2. To avoid the ‘dummy trap’, the model is estimated with a full set of dummies, omitting the export and import dummy for one country, but including the constant term. The dummy variables represent all country-specific factors that are relevant for their propensity to trade, either in the role as exporter or as importing country. In this way, our gravity equation reflects the theoretically derived generalized gravity model (see Chapter 2). Following the introduction of country-specific dummies, the coefficients on the bilateral variables change somewhat in quantitative terms. However, they remain positive and statistically significant at 1%, now including the estimated effect of religion as well. Despite the quantitative changes in the estimates, the qualitative effects do not change in comparison to the extended traditional gravity equation presented in Specification (3).

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[7] The rationale for the extended model is not so much that it increases the share of explained variation in trade flows (the adjusted R^2 rises only slightly). It is by no means an uncommon finding that the proportion of the variance in trade flows explained by the gravity model does not rise substantially after the basic gravity variables have been accounted for. The bilateral dummies in Specification (3) correct for the effects of various unobserved trade costs on bilateral trade, that would otherwise bias the estimates on the basic gravity variables.

4.4 The effect of institutions

In this section we extend the analysis in the previous section and focus on the explanatory role of institutional quality and institutional distance for the intensity of bilateral trade.[8] The economic rationale for including these variables is simple. A better *quality* of the institutional framework reduces uncertainty about property security, contract enforcement and general economic governance. This reduces transaction costs directly, by increasing the security of property rights, as well as indirectly, by increasing the level of trust in the process of economic transactions. Institutional distance, or *heterogeneity* in the perceived quality of institutions, raises unfamiliarity with the institutional setting in the trade partner's country. This causes adjustment costs and other transaction costs, related to differences in informal procedures of business, and may reduce mutual trust.[9] In general, we expect that traders are more capable to operate in institutional settings that are similarly effective in terms of good governance. Familiarity with the quality of formal governance generates familiarity with informal solutions to use the capacity of the formal institutional system as effectively as possible, or to complement formal institutions with informal mechanisms of governance. Note that the reduction in trade costs due to familiarity with foreign levels of institutional quality is identified separately from the direct effect of institutional quality *levels* on trade costs. Institutional homogeneity affects the relative compatibility of traders from different countries. A country with a low level of institutional quality will trade less than a country with good governance, but the reduction is less pronounced if the level of institutional quality in the partner country is low as well because of smaller institutional distance. Thus, we can separately identify a direct level-effect of institutional quality on trade, and an additional effect of the difference in institutional quality between the trading countries.

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[8] See Chapter 2 for a more detailed discussion of the relation between institutions and trade costs.

[9] Similarity of informal norms resulting from a similar experience with formal governance is an important potential factor of cultural familiarity (see Chapter 2). Chapter 6 extends the analysis of the cultural dimension of intangible barriers to trade.

4.4.1 The effects of institutional quality and institutional heterogeneity

Table 4.3 presents the results for gravity equations supplemented with institutional quality and institutional heterogeneity. The first specification extends the augmented gravity equation from Table 4.2 with institutional quality levels of the exporting and importing countries. The regression results are based on the composite index of overall institutional quality (see section 4.2). Separate results for the six aspects of institutional quality provide a comparable picture and have been omitted here for brevity.[10] Because the indicators of institutional quality vary between roughly –2.5 and +2.5, we cannot log-linearize the relation between institutions and trade, without first arbitrarily re-scaling the data to ensure positive values. Therefore, we have chosen to express the relation between trade and institutional quality in a semi-logarithmic form. The effect sizes reported are semi-elasticities. To interpret the impact on trade flows suggested by these effect sizes, we address the effect of a typical difference in institutional quality within our sample. The impact on trade of a rise in institutional quality of one standard deviation, starting from the average overall institutional quality, gives a good indication of the average impact of variation in institutional quality on trade flows, all else equal.

Although differing according to the country's role as exporter or importer, the impact of variation in the effectiveness of governance institutions on bilateral trade is substantial. Increasing the overall quality of institutions one standard deviation above its mean level would raise bilateral exports by 50%, and bilateral imports by 37%.[11] Apparently, trade costs associated with the effectiveness of institutions seriously affect the distribution and size of bilateral trade flows.

Yet, the introduction of institutional quality in the gravity equation does not substantially increase the explained share of variation in trade flows. Omitted variables bias turns out to be an essential element in interpreting the gravity model with institutions.

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[10] The reader is referred to Table 3 in De Groot et al. (2004).

[11] The mean overall quality of governance in the sample is 0.19, with a standard deviation of 0.85. For example, the average trade increase figure for an exporting country, with an estimated semi-elasticity in specification (1) of 0.48, is computed as follows: $d\ln(T_{ij}) = 0.48 \times 0.85$ so $dT_{ij}/T_{ij} = e^{0.48 \times 0.85} - 1 = 0.50$.

Table 4.3 Extended gravity equations: institutional quality and institutional heterogeneity

	(1) Institutional quality	(2) Specification (2) to (4): Institutional quality and heterogeneity. Heterogeneous if difference in inst. quality :	(3)	(4)	(5) Institutional quality and – distance
		>1 standard deviation	>2 standard deviations	>3 standard deviations	Kogut-Singh index
Log GDP exporter	1.20***	1.20***	1.20***	1.20***	1.20***
	(100.02)	(100.16)	(100.44)	(100.23)	(100.47)
Log GDP importer	0.99***	0.99***	0.99***	0.99***	0.99***
	(76.75)	(76.78)	(76.75)	(76.87)	(76.85)
Log Distance	–1.13***	–1.13***	–1.13***	–1.14***	–1.13***
	(49.91)	(49.92)	(49.99)	(50.19)	(50.01)
Log GDP/cap exp.	–0.14***	–0.14***	–0.15***	–0.14***	–0.13***
	(4.92)	(4.77)	(5.00)	(4.71)	(4.57)
Log GDP/cap imp.	–0.12***	–0.11***	–0.12***	–0.11***	–0.11***
	(4.28)	(4.13)	(4.37)	(4.05)	(3.91)
Border Dummy	1.04***	1.02***	1.01***	1.02***	1.00***
	(7.90)	(7.73)	(7.67)	(7.78)	(7.58)
Trade area Dummy	0.50***	0.46***	0.44***	0.48***	0.43***
	(6.82)	(6.15)	(6.01)	(6.54)	(5.75)
Language Dummy	0.41***	0.41***	0.41***	0.40***	0.39***
	(4.48)	(4.46)	(4.44)	(4.39)	(4.29)
Colonial Dummy	0.73***	0.73***	0.73***	0.74***	0.74***
	(9.47)	(9.50)	(9.48)	(9.58)	(9.57)
Religion Dummy	0.11**	0.10**	0.10**	0.10**	0.10**
	(2.22)	(2.16)	(2.15)	(2.17)	(2.12)
Instit. quality exporter	0.48***	0.49***	0.50***	0.47***	0.48***
	(10.04)	(10.25)	(10.51)	(9.90)	(10.18)
Instit. quality importer	0.37***	0.38***	0.39***	0.36***	0.37***
	(8.24)	(8.46)	(8.76)	(7.99)	(8.28)
Institutional heterogeneity		–0.16***	–0.31***	–0.65***	
		(4.07)	(7.30)	(6.15)	
Institutional distance					–0.06***
					(7.75)
Constant	–33.70***	–33.73***	–33.83***	–33.81***	–33.90***
	(76.89)	(77.07)	(77.23)	(77.14)	(77.49)
Observations	13682	13682	13682	13682	13682
Adjusted R-squared	0.69	0.69	0.69	0.69	0.69
F-statistic	2636.62	2425.18	2433.06	2437.88	2429.68

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log aggregate bilateral exports.

Evidence for this is provided by the fall in effect size of the parameters for common trade bloc and colonial history. Most prominently, however, the clearly positive effect of income per capita levels on trade disappears, after institutions have been included in the gravity model. The effect of the level of development on trade becomes significantly negative for both the import side and the export side. Anderson and Marcouiller (2002) argue that excluding institutional effectiveness from the gravity model can obscure a negative relation between income per capita and expenditure shares on traded merchandize, because of the high correlation between per capita income and the quality of governance. This relation between the share of expenditure on traded merchandize and GDP per capita results from a shift in the structure of production and consumption, from commodities into services. The shift in expenditure shares offers an explanation for the finding that wealthy countries engage in less commodity trade, all else equal, after institutional quality levels have been included.

Our results confirm the findings in Anderson and Marcouiller (2002), and suggest that the standard gravity model including income per capita as explanatory variable suffers from severe omitted variable bias, if institutions are not taken into account.[12] Stated alternatively, institutional quality helps opening up the black box we referred to before, which is created by the inclusion of GDP per capita levels in the gravity model. On the basis of these findings, we can conclude that institutional quality offers an explanation for the puzzling finding that rich countries trade more in general, while poor countries trade less, both amongst themselves and with rich countries (ceteris paribus). Kaufmann et al. (2002, p. 4) note the "strong positive association across countries between governance and per capita incomes". High-income countries support high quality institutional systems that reduce transaction costs. Hence, a possible solution for the missing theoretical explanation of why rich countries trade more has been found.

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[12] In econometric terms, the bias in coefficients reflects correlation between GDP per capita and the 'omitted variable', e.g. institutional quality. The correlation coefficient between income per capita and institutional quality is 0.84. Although the correlation with GDP per capita is high, this "does not imply that income per capita and institutional quality are necessarily linked" (Anderson and Marcouiller, 2002). In other words, the data still exhibit sufficient independent variation in institutional quality and GDP per capita. Thus, the effect of both variables on trade can still be estimated, and the coefficients will be unbiased and consistent. In fact, if concern about the identifiability of either variable were to lead to the choice of omitting institutional quality from the model, we would leave out a theoretically appropriate regressor, and the estimate on the effect of GDP per capita would suffer from omitted variables bias.

The remaining columns in Table 4.3 include several indicators to capture the effect of bilateral heterogeneity in the quality of institutions. We discuss different specifications depending on the selection criteria of classifying countries as heterogeneous in terms of institutional effectiveness. In section 4.2, we have explained how we constructed the variables for institutional heterogeneity. Specifications (2) to (4) introduce dummy variables that take the value 1 if the absolute bilateral difference in institutional effectiveness is more than a stated difference expressed in terms of the standard deviation of institutional quality in the sample. In the second specification of Table 4.3, a difference above one standard deviation is associated with institutional heterogeneity. The next columns use two and three standard deviations respectively. Alternatively, specification (5) includes the Kogut-Singh index of institutional distance explained in section 4.2. This index allows institutional distance to vary on a continuous scale.

The effect of institutional heterogeneity on trade is negative and statistically significant in all specifications. The parameter estimates for the other explanatory variables remain more or less unaffected after the extension with institutional distance.[13] In particular, when accounting for the effect of institutional distance, the impact of institutional quality remains highly significant and positive. Indeed, institutional distance and institutional quality have separate effects on trade costs and trade patterns.

For the dummy variables of institutional heterogeneity, the effect differs somewhat depending on how inclusive the set of 'dissimilar' countries is. With one standard deviation as the criterion, 50% of the countries classify as heterogeneous in terms of governance effectiveness. Institutional heterogeneity in this case lowers trade by an estimated 15%.[14] We might expect that transaction costs related to institutional distance are more important if institutional settings are considerably different. Therefore, we considered more tight

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[13] There is some evidence that institutional distance corrects for an upward omitted variable bias in the effect of common membership in a regional integration agreement (trade bloc). Apparently, member countries in regional integration areas tend to have a more similar level of institutional quality.

[14] The percentage trade impact of a dummy variable k in the gravity equation can be computed as follows: $\left(e^{\beta_k} - 1\right) \times 100\%$.

classifications of institutional heterogeneity, at a cut-off criterion of two or three standard deviations. The fraction of heterogeneous country pairs decreases to 17% and 2%, respectively. In effect, this means that only countries that differ very widely in terms of institutional quality are seen as dissimilar. Adjustment costs and additional lack of trust and confidence in the security of transactions begin to accumulate when differences in the institutional environment between exporters and importers increase. Then, unfamiliarity adds an extra dimension to the transaction costs of bilateral trade. The average trade effect of institutional heterogeneity rises substantially using these alternative definitions. For a cut-off criterion of two (three) standard deviations, trade between two heterogeneous countries is estimated to be 27% (48%) lower, all else equal.

The results for the heterogeneity dummies reveal that institutional distance consistently lowers trade. Moreover, the larger the bilateral distance in institutional quality, the larger the negative effect on their bilateral trade. The final specification in Table 4.3 captures these stylized facts with a continuous indicator of institutional distance. The Kogut-Singh index reflects the average bilateral distance on the underlying indicators of institutional quality as a fraction of their respective sample variances (see section 4.2). The effect of institutional distance on trade, thus expressed, remains negative and significant. This relation is once again expressed in a semi-logarithmic form, similar to that of institutional quality. Increasing institutional distance one standard deviation above its mean level is estimated to reduce bilateral trade by 12%.[15]

Because of the high correlation between GDP per capita and institutional quality, institutional distance and differences in GDP per capita will be correlated as well. As a result, the effect of institutional distance on trade presented in Table 4.3 may simply proxy for the Linder effect mentioned before. Countries trade more if they have similar levels of per capita income, because of similar preferences and a similar output mix. Estimates in Appendix 4A

[15] The mean institutional distance in the sample is 2.02 and the standard deviation equals 2.12. See footnote 11 above for further details on the computation of a variable's trade impact when it is specified as a semi-elasticity.

indeed show that the Linder effect occurs. Although the effect size of institutional distance declines somewhat, the relation to bilateral trade remains significantly negative. This suggests that Linder effects and trade costs arising from unfamiliarity with the institutional framework independently affect trade patterns.

4.4.2 Sensitivity analysis

Table 4.4 subjects the findings in the previous sub-section to some sensitivity checks. First, it extends the gravity equation by including importer tariff levels to capture policy barriers to trade. Next, we estimated some specifications with country-specific fixed effects, at the export and import side, respectively. These extensions comprehensively control for all exporter- or importer-specific effects.

It has been argued that institutional quality indicators simply proxy for traditional formal tariff and non-tariff barriers (NTB) to trade (see Anderson and Marcouiller, 2002). Institutional quality reflects the security of property and contract enforceability in transactions in general. This relates to law enforcement and the quality of property rights institutions. Contract enforceability involves the security of property rights in transactions between private parties. Another important aspect of property security relates to the transparency of policy and the extent to which it is impartial and market friendly. Corruption and lack of transparency about economic policies create uncertainty about costs and benefits of transactions. As argued in Chapter 2, extra security costs are involved in international trade, relative to domestic trade. Trade policy only deals with the costs of direct policy instruments related to trade. Partly, these are tangible barriers to trade (tariffs), where the trade costs involved are directly quantified. Another part consists of more or less intangible barriers related to NTBs (licenses, quota, exchange regulations etc.), which raise unobserved trade costs.

Although trade policy and institutional quality are related, the former reflects only one aspect of the latter. In particular, high tariffs and NTBs are generally conceived as market unfriendly policy and reduce the transparency of the institutional environment of international trade. Moreover, restrictive trade policy is discriminatory in nature and may provide incentives for corruption. This reduces property security in trade. Still, we would argue that the emphasis of our index of institutional quality is on the general institutional environment, including regulation of business in general, rather than formal regulation of trade per se. Moreover, trade policy barriers are unrelated to other aspects of institutional quality, such as contract enforceability. Therefore, we may expect tariffs, NTBs and general institutional quality to have separable effects on trade. Still, institutional quality may capture some elements of NTBs, as well as indirect costs of import tariffs. To check whether our results are sensitive to direct measures of trade policy, Table 4.4 includes indicators for tariff protection along with the indicators of institutional quality and distance.[16]

The benchmark specification (1) in Table 4.4, without tariffs, repeats specification (5) from Table 4.3 for the sample that bilateral tariff data are available for. The second specification includes trade-weighted applied importer tariffs, which statistically significantly reduce trade.[17] According to specification (2), a 1 percentage point increase in the applied bilateral tariff rate approximately leads to a 0.37% reduction in bilateral trade (for small tariffs). Apart from tariffs, the regional integration dummy also reflects the effect of traditional policy barriers to trade. Once tariffs have been controlled for, the regional bloc dummy mostly captures NTB and regional concentration effects on trade. The regression results suggest that most explanatory variables are robust to the extension with bilateral import tariffs.[18]

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[16] We do not include separate data on NTB coverage in the model, because the data are scarce and problematic (see Anderson and Van Wincoop, 2004). Moreover, for data that are available, Anderson and Marcouiller (2002) show that correlation with institutional quality data is generally sufficiently low not to expect much bias. In any case, given the poor quality of direct NTB data, there is no harm in viewing institutional quality partly as reflecting NTBs, amongst other (in)tangible trade barriers.

[17] We include the commonly used logarithmic specification for the bilateral importer tariff (see Chapter 2): $TAR_{ij} = \ln(1+tariff_{ij})$. Results using simply the tariff rate are qualitatively comparable (available upon request). We also tried trade-weighted most favoured nation (MFN) tariffs instead of applied tariffs. The results are again comparable (available upon request).

[18] The differences in effect sizes compared to Table 4.3 are due to the smaller sample, for which importer bilateral tariff data are available. For comparison, see specification (6) in Table 4.4, which is the fixed effects estimation for the full sample (excluding the tariff variable and the country-specific variables).

Table 4.4 Extended gravity equations: robustness

	(1) Without tariffs	(2) Applied tariffs	(3) Exporter specific effects	(4) Importer specific effects	(5) Fixed effects (including tariffs)	(6) Fixed effects: full sample
Log GDP exporter	1.23***	1.24***		1.24***		
	(61.08)	(61.21)		(62.78)		
Log GDP importer	0.91***	0.89***	0.92***			
	(47.25)	(45.09)	(49.29)			
Log Distance	–1.30***	–1.26***	–1.39***	–1.21***	–1.39***	–1.31***
	(33.55)	(31.88)	(34.25)	(25.87)	(28.18)	(41.41)
Log GDP/cap exp.	–0.11**	–0.10**		–0.10**		
	(2.26)	(2.12)		(2.06)		
Log GDP/cap imp.	–0.17***	–0.16***	–0.17***			
	(3.34)	(3.30)	(3.74)			
Border Dummy	0.42**	0.42**	0.45**	0.54***	0.53***	0.87***
	(2.16)	(2.13)	(2.22)	(2.73)	(2.62)	(6.65)
Trade area Dummy	1.14***	1.17***	0.73***	1.18***	0.65***	0.21***
	(12.34)	(12.47)	(7.14)	(12.08)	(5.76)	(2.69)
Language Dummy	0.30*	0.30*	0.48***	0.26	0.42**	0.48***
	(1.65)	(1.70)	(2.58)	(1.54)	(2.35)	(5.18)
Colonial Dummy	0.42**	0.48***	0.21	0.53***	0.23	0.73***
	(2.45)	(2.75)	(1.14)	(3.16)	(1.30)	(8.77)
Religion Dummy	0.15*	0.11	0.19**	0.23***	0.36***	0.34***
	(1.93)	(1.50)	(2.39)	(2.89)	(4.15)	(6.86)
Instit. quality exporter	0.45***	0.46***		0.44***		
	(5.52)	(5.67)		(5.62)		
Instit. quality importer	0.46***	0.26***	0.28***			
	(6.00)	(3.29)	(3.67)			
Institutional distance	–0.04**	–0.06***	–0.05***	–0.04**	–0.01	–0.02**
	(2.40)	(4.15)	(2.85)	(2.52)	(0.68)	(2.43)
Bilateral importer tariff		–0.37***	–0.36***	–0.42***	–0.44***	
		(7.97)	(7.61)	(7.09)	(7.05)	
Constant	–30.97***	–30.12***	–5.72***	–9.35***	16.55***	11.00***
	(40.71)	(39.74)	(7.99)	(13.62)	(23.42)	(27.59)
Observations	4397	4397	4397	4397	4397	13682
Adjusted R-squared	0.71	0.72	0.75	0.73	0.77	0.74
F-statistic	833.97	767.65	117.84	229.05	101.21	173.84

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log aggregate bilateral exports.

The central question is whether the effect of institutional quality and institutional distance is robust to the extension with tariff protection. The results show that variation in trade policy and variation in institutional quality separately help to explain variation in trade patterns. The effect of importer institutional quality decreases in size, indicating that import tariffs and institutional quality are related across countries, as expected. The separate contributions of these trade costs sources remain identified, though. The negative effect size of institutional distance is strengthened, possibly because tariffs filter out trade preferences between ‘good governance’ developed nations and less developed nations that lag behind in terms of institutional quality (such as for the Generalized System of Preferences, GSP).

Adding exporter and importer specific effects, in specifications (3) to (5) of the table, shows that institutional quality and import tariffs are robust to country-specific omitted variables bias. Specification (5) suggests that the effect of institutional distance is not statistically significantly different from zero in a model with full-blown country-specific fixed effects. The last model, though, estimated for the full sample without the tariff variable, retains a significantly negative effect of institutional heterogeneity on trade.

4.5 Conclusions

Recent research draws attention to the importance of intangible barriers to international trade. The institutional framework is an important element in explaining the size of unobserved transaction costs. This chapter has therefore explicitly investigated the effect of institutions on the patterns of bilateral trade. It starts from the argument that the quality of formal rules that govern economic interaction is an important determinant of the uncertainty and opportunism in market exchange. A low quality of governance increases the transaction costs that are incurred in exchange. The impact of institutions on private trade and investment is argued to be at least as important in international exchange as in domestic transactions. Moreover, the quality of formal rules affects the informal norms and procedures of doing business that are devised to cope with transactional uncertainty. This creates the possibility that countries with similar levels of institutional quality may be familiar with each others business practices, which reduces transaction costs.

In this chapter, we find that institutional quality has a significant, positive and substantial impact on bilateral trade flows. Institutional distance, on the other hand, negatively affects bilateral trade. This reflects the adjustment costs and extra uncertainty involved when traders do not share a sufficiently similar level of institutional support. Although the institutional framework interacts with specific trade policy, the relation between trade and institutional quality and distance is robust to the inclusion of formal trade barriers, such as bilateral importer tariffs and a dummy for membership in a regional integration agreement. This suggests that trade barriers related to the general institutional environment and trade policy independently affect trade costs and trade patterns. These results support the hypothesis that institutional variation is an important determinant of intangible barriers to trade.

The positive correlation between income per capita and the quality of institutions gives rise to an explanation of why high-income countries trade disproportionately with all trading partners and especially amongst each other, while low-income countries trade less. Generally good governance lowers transaction costs for trade between high-income countries, while trade between low-income countries suffers from high insecurity and transaction costs.

An important implication emerges from our separate focus on country-specific quality of institutions and bilateral distance in terms of institutional effectiveness. The results show that institutional differences, in terms of the security of property and contract enforceability, progressively reduce bilateral trade. This implies that unfamiliarity costs are especially high when countries differ widely in terms of institutional quality. Institutional dissimilarity affects trade most between countries with the best institutional quality and those that have the lowest effectiveness. Potential trade between these countries is diverted to partners closer in terms of institutional effectiveness. The impact of trade diversion is likely to be most severe for low security countries. Countries with poor formal institutions, apart from the negative effect of low institutional support on their mutual trade, somewhat bounce back into trade with similar countries. Thus, they cannot benefit as much from trade with highly developed countries, despite the potential comparative advantages, knowledge spillovers, and large sales markets. These countries may become locked into a situation of low economic performance. This provides an additional argument for serious policy concern with the international promotion of good governance.

Appendix 4A GDP per capita in the gravity model

In this appendix, we provide a further analysis and discussion of the role of GDP per capita and population levels in the gravity model of bilateral trade. An investigation of the relation between trade and the level of economic development implies that we encounter questions concerning the relation between the size of economies and their openness to trade; and the relationships between per capita incomes and comparative advantage, Linder-style preference effects, and the extent of specialization.

In the main text, we have concluded that the effect of GDP per capita levels on trade is not robust to the extension of the gravity model with variables reflecting institutional quality levels. Hence, variation in institutional quality across countries provides an explanation for the stylized fact that rich countries are more open to trade than can be explained by the basic gravity equation. Because GDP per capita acts as a proxy for institutional quality, the standard gravity equation used in much of the literature, which includes GDP per capita or population as explanatory variables, suffers from omitted variable bias. This leads to a substantial change in the way we interpret the standard gravity model of bilateral trade. Traditionally, the literature has suggested several alternative justifications to include either GDP per capita or population in the gravity model. This appendix provides an overview of some different views on the use of GDP per capita in the gravity model and discusses their appropriateness and application. In doing so, we will estimate some additional specifications of the gravity equation. One of the issues concerned is whether the effect of institutional heterogeneity may proxy Linder-style preference effects instead, or vice versa.

4A.1 Population and GDP per capita in the standard gravity equation

The standard specification of the gravity equation for bilateral trade often includes either GDP per capita or population of the trading countries (see, e.g., Oguledo and MacPhee, 1994, for an overview and references).

Equations (4.3) and (4.4) below illustrate both alternative specifications of the standard gravity equation:

$$\ln(T_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(Pop_i) + \beta_4 \ln(Pop_j) + \beta_5 \ln(D_{ij}) + \varepsilon_{ij}\,, \quad (4.3)$$

$$\ln(T_{ij}) = \gamma_0 + \gamma_1 \ln(Y_i) + \gamma_2 \ln(Y_j) + \gamma_3 \ln(y_i) + \gamma_4 \ln(y_j) + \gamma_5 \ln(D_{ij}) + \varepsilon_{ij}\,. \quad (4.4)$$

As illustrated by Frankel (1997, p. 58), these specifications are mathematically equivalent, with amongst others $(\gamma_1 + \gamma_3) = \beta_1$ and $\beta_3 = -\gamma_3$. However, they can give rise to different interpretations of the underlying economic mechanisms. This section introduces some of the interpretations attached to population and GDP per capita variables in the literature. In the next section, we will discuss the theoretical foundations of these interpretations, and discuss their appropriateness to describe the stylized facts.

Specification (4.3) includes population separately in the gravity equation, which is interpreted as a measure of the size of countries. The expected effect of population size on trade is a-priori indeterminate (Oguledo and MacPhee, 1994). A large population, it is argued, captures economies of scale on the domestic market and is positively related to geographical size and the presence of natural resource endowments (e.g., Frankel, 1997; Wang and Winters, 1991). On the one hand, countries with a large population are more self-sufficient and rely less on international trade, as a percentage of GDP. As a result, the expected sign of the population coefficients in the gravity equation would be negative. On the other hand, economies of scale on a large domestic market promote division of labour and specialization, which creates the opportunity and desire to trade in a wider variety of goods (Oguledo and MacPhee, 1994). Hence, the expected effect of population size may be positive as well.

Alternatively, the gravity equation can be defined as in equation (4.4). The (logged) levels of GDP reflect the size of the market, while GDP per capita reflects the level of economic development. This specification implicitly assumes that economic size and the level of economic development have separate effects on bilateral trade. The sign for GDP per capita coefficients would be positive, to reflect that rich countries are more open to trade. Many studies motivate the inclusion of GDP per capita levels by arguing that a higher income per capita allows for more specialization and increases intra-industry trade in a wider variety of products (see, e.g., Dell'Ariccia, 1999; Eichengreen and Irwin, 1995 and 1998; Frankel et al., 1995 and Eaton and Tamura, 1994). An alternative explanation, referred to by Wang and Winters (1991) and Frankel (1997), argues that richer economies can afford to spend more on foreign varieties, whereas low income countries are dominated by subsistence farming. Foreign goods are luxury products, because of the fixed costs involved in order to establish trade relations. Therefore, income elasticities of traded goods would exceed unity.

The use of GDP per capita in the gravity equation has also been motivated as an indirect measure of relative factor endowments (Eaton and Tamura, 1994; Baldwin, 1994). High incomes per capita reflect relatively high capital-labour ratios. Thus, GDP per capita can be related to factor-intensity explanations of trade.

4A.2 GDP per capita and population: confronting theory and stylized facts

In this section, we confront the various interpretations of the role of population and income per capita in bilateral trade with basic trade theory and empirical results. First, we discuss the link between openness to trade and the basic gravity equation parameters, and address the relation between income per capita and trade theories based on product differentiation. Subsequently, factor-intensity and preference effects in the gravity equation, using GDP per capita, will be dealt with. This also leads to a possible new interpretation of the effect of institutional distance on trade patterns. The second part of this section compares the theoretical arguments to some empirical results, regarding the effect of GDP per capita levels on bilateral trade. We conclude the appendix with a discussion of the implications for the interpretation of GDP per capita effects on trade.

Some of the main arguments introduced above to include population or GDP per capita in the gravity equation referred to openness to trade and market size. The effect of population may be negative, to reflect that large countries have a large internal market and are less open to trade. Alternatively, a large and diversified market increases the potential for (intra-industry) trade, which would be supported by a positive sign of the GDP per capita parameters, some say, or a positive effect of population, others claim. To discuss these, at times, contradictory hypotheses most effectively, it is instructive to consider a basic gravity model, based on frictionless trade and identical, homothetic preferences across countries.[19] The model can be derived from Helpman-Krugman type new trade theory (e.g., Helpman and Krugman, 1985; Helpman, 1987), but also from neoclassical trade theory (see Deardorff, (1998).

$$T_{ij} = Y_i \frac{Y_j}{Y_w}, \text{ where: } Y_w = \sum_j Y_j . \tag{4.5}$$

Equation (4.5) simply states that, in balanced-trade equilibrium, each country *i* generates import demand for its output from any country *j* according to that country's share in worldwide income. This simplified model of bilateral trade generates trade patterns that correspond well to the stylized facts about openness and market size. First, large countries are less open to trade, because the share of their output traded domestically is higher. A larger exporting country *i* exports proportionately more to any importing country *j*, but the share of its output traded domestically increases.[20] This simply reflects that the domestic market represents a larger share of worldwide demand. Second, a larger output implies that a country produces a wider variety of products, and generates greater demand for its export products (cf. Wang and Winters, 1991). This is seen from equation (4.5) as an increase of its exports to any importing country *j*, and simply reflects that country *i* produces a larger share of worldwide output.

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[19] This model follows from the model discussed in Chapter 2 if we assume the absence of trade barriers, so that the trade costs factor $\tau^{ij} = 1$. In that case, prices of all varieties will be the same in equilibrium, and equation (4.5) follows.

[20] That is: $T_{ii} = Y_i Y_i / Y_W$ rises twofold, because the country itself produces more products (or varieties), and has more purchasing power as well.

The striking fact of this exercise is that the model can explain stylized facts concerning openness and replicate the flavour of the (intra-industry) trade-potential argument, both related to economic size, without any role for population or income per capita. Market size and supply potential are completely reflected by GDP levels. Note as well that there is no direct relation between openness to trade and the size of GDP coefficients, as is often suggested in the literature. The elasticities of trade with respect to GDP do not have to be smaller than 1 for large countries to be less open than smaller ones.[21]

The argument that a positive effect of GDP per capita would indicate the relevance of new trade theories of product differentiation does not hold. Theories of imperfect product substitution and trade do not imply a definite role for income per capita (Frankel, 1997, p. 58). For example, standard new trade models do not imply that rich countries specialize more, and hence trade more (as stated, e.g., by Frankel et al., 1995). In fact, these models imply that smaller countries (with lower GDP) are more specialized and depend more on trade for the consumption of a wide variety of products (see, e.g., Krugman, 1979 and 1980).

The gravity model in equation (4.5) does not introduce an explicit role for factor endowments, because it focuses on the volume of aggregate trade. As shown by Deardorff, neoclassical trade theory, based on comparative costs, generates the basic gravity equation for aggregate trade. Given the assumption that preferences are identical and homothetic, that countries buy from all suppliers and similar products are perfect substitutes, gross aggregate bilateral trade will be fully determined by total export supply and import demand, as reflected by GDP levels.[22] This will even be the case, if both countries have equal factor endowments and consequently equal comparative advantage. In this case, standard neoclassical Heckscher-Ohlin models predict that net inter-industry trade between the countries will be zero. However, as consumers buy equal fractions of the homogeneous good from both countries,

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[21] In fact, most theoretical derivations of the gravity equation, such as equation (4.5), predict that the GDP coefficients should be (close to) one.

[22] This is based on the idea that producers of homogeneous products put their outputs into a world pool of each industry, from which consumers randomly draw their consumption. Because trade is assumed to be frictionless, producers and consumers are indifferent between destination and source of the product (see Deardorff, 1998).

gross aggregate trade (including the flow of homogeneous goods back and forth) will be determined by equation (4.5). Thus, in the simplest case of homothetic preferences, GDP per capita levels do not enter the gravity equation to reflect relative factor-intensity effects on bilateral trade.

If we generalize the model a bit in the 'neoclassical world' we arrive at an interesting result. If preferences are not identical and/or not homothetic, Deardorff shows that aggregate bilateral trade in general does not follow the pattern described by equation (4.5). Specifically, he states that bilateral trade will exceed (be lower than) the level that can be explained by GDP levels alone, if the exporting country produces above-average amounts of what the importing country consumes in above-average (below-average) amounts. The result is rather intuitive, and can be illustrated by the following specific case, which leads to an interesting stylized regularity in trade patterns that can be tested empirically (see Deardorff, 1998, p.16). Assume that preferences are identical, but non-homothetic across countries. Moreover, suppose that high-income consumers spend larger budget shares on capital-intensive products, which are income-elastic. Because per capita GDP rises with the capital-labour ratio, capital-abundant countries will have relatively high consumption of capital-intensive goods. From comparative advantage theory, we expect capital-rich countries to produce relatively much of these capital-intensive goods. As a result, the hypothesis will state that high-income countries trade relatively more with each other than with low-income, labour-abundant countries. This is somewhat similar to the argument put forward earlier, that traded goods are luxury products. Both hypotheses assume that preferences are non-homothetic. However, the hypothesis put forward here does not imply that all traded goods are luxuries. In other words, low-income countries will trade more with each other as well, because they produce and consume the same (traded) goods in relatively high proportions.

The argument leads to the same hypothesis as put forward by Linder (1961), who used a distinct model based on similar preferences and similar but differentiated products to arrive at the same conclusion (Frankel, 1997). Countries with similar levels of per capita income will trade more with each other. The Linder effect can be reflected in the gravity equation by including the absolute difference between the (logs of) per capita GDP as explanatory variable, as in equation (4.6).

$$
\begin{aligned}
\ln(T_{ij}) &= \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(y_i) + \beta_4 \ln(y_j) + \beta_5 \ln(D_{ij}) + \beta_6 Adj_{ij} \\
&+ \beta_7 RIA_{ij} + \beta_8 Lan_{ij} + \beta_9 Col_{ij} + \beta_{10} Rel_{ij} + \beta_{11} IQ_i + \beta_{12} IQ_j + \beta_{13} ID_{ij} \\
&+ \beta_{14} \left(| \ln(y_i) - \ln(y_j) | \right) + \varepsilon_{ij}
\end{aligned} \quad . \tag{4.6}
$$

The Linder hypothesis states that the absolute difference will have a negative effect. Frankel (1997) points out that traditional Heckscher-Ohlin theory would predict that the sign of the absolute difference were positive; capital-rich, high-income countries trade relatively more with labour-rich, low-income countries, because of comparative advantages. Recall that our basic neoclassical model, as described by Deardorff (1998), does not yield this prediction for aggregate bilateral trade, unless consumers in high-income countries consume relatively high shares of labour-intensive goods, which seems unlikely.[23] In any case, the consideration of neo-classical factor-intensity and Linder-style preference effects does not provide a justification to include GDP per capita levels as such in the gravity model for aggregate bilateral trade.[24]

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[23] Still, the pattern described by Frankel could apply if trade is impeded by trade barriers (transport and transaction costs). If preferences are identical and homothetic, factor prices do not equalize and specialization is *in*complete (such that each product is produced by more than one supplier), countries with similar factor endowments (and hence similar factor prices) will trade relatively little on aggregate. They relatively specialize in the production of goods that have similar factor-intensities. If they produce exactly the same homogeneous product, they will not trade that product. The price of the foreign product will exceed the domestic price, because of trade costs. This is not the type of Heckscher-Ohlin world that Deardorff (1998) discusses explicitly, though. When addressing impeded trade, he assumes perfect specialization, such that each country will trade with all others (i.e., each good is produced by a single exporter, and demanded by all consumers). He admits that this is only a special case of the neo-classical world with positive trade costs.

[24] At the disaggregate level of trade, there is more reason to include the level of GDP per capita in both countries as explanatory variables for sectoral trade. It can, for example, reflect the effect of the extent of comparative advantage or of preferences for goods from a particular sector (vis-à-vis the rest of the world) on the size of a country's exports and imports in that sector (see Bergstrand, 1989; a recent application is Nahuis, 2004). At the aggregate level, however, one has to focus on bilateral differences in comparative advantages and tastes (reflected by differences in GDP per capita) to explain aggregate bilateral trade. This reflects the fact that, at the aggregate level, all countries have comparative advantages and preferences for something.

All in all, much of the traditional reasoning to include either population or GDP per capita in the gravity equation does not have a natural and firm foundation in standard trade theory. Though some traditional arguments about GDP per capita or population size might in principle be incorporated theoretically, stylized facts concerning openness and export potential can be accounted for using much simpler specifications of the gravity model. The presence of natural resources, correlated with geographical size and population size, could reduce openness beyond what can be reflected by GDP, although this is not necessarily implied by the general case of theoretical gravity discussed here and in Chapter 2. But that would be best proxied by including direct measures of resource endowments or geographical size.[25] Furthermore, it is possible and perhaps even realistic to assume that trade is to some extent a luxury, as argued in the previous section. One could conceive of a model that takes this into account (using, e.g., Stone-Geary utility), in which traded goods shares would rise with GDP per capita over some range of economic development. However, we believe that it is more probable that deviations from the model in equation (4.5), and hence any role for GDP per capita, are related to trade frictions and omitted (trade-resisting or trade-inducing) variables.

In the end, it is a matter of empirics to judge whether income per capita independently affects bilateral trade and in which direction, and whether it reflects the impact of other omitted variables as well. Therefore, we will discuss the empirical results for some alternative specifications of the gravity model. Table 4A.1 presents these results. We address the robustness of GDP per capita and population effects and test the Linder hypothesis.

Many studies on bilateral trade have found that bilateral trade increases with the levels of GDP per capita in the trading countries (e.g., Rose, 2004; Frankel and Rose, 2002), or equivalently, falls with population levels (e.g., Wang and Winters, 1991; Van Bergeijk and Oldersma, 1990; Bikker, 1987). In the main text, we referred to Deardorff (1998, p. 16), who has summarized the stylized facts as follows: “high-income countries trade disproportionately

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[25] Chapter 6 will pay some attention to extensions with geographical variables.

more than the gravity equation would suggest with all trading partners and not just among themselves, while low-income countries trade less".

Table 4A.1 GDP per capita and population effects

	(1) GDP/pop	(2) Population	(3) Population and IQ	(4) GDP/pop and institutions	(5) GDP/pop and import tariffs	(6) Linder effect
Log GDP exporter	1.18***	1.28***	1.05***	1.20***	1.22***	1.20***
	(99.00)	(108.95)	(39.78)	(100.47)	(60.73)	(100.46)
Log GDP importer	0.97***	1.04***	0.87***	0.99***	0.87***	0.99***
	(75.46)	(88.42)	(35.51)	(76.85)	(45.47)	(76.85)
Log Distance	–1.10***	–1.10***	–1.13***	–1.13***	–1.25***	–1.13***
	(48.35)	(48.35)	(49.91)	(50.01)	(31.73)	(49.91)
Log GDP/cap exp.	0.10***			–0.13***	0.12***	–0.15***
	(6.39)			(4.57)	(4.69)	(5.01)
Log GDP/cap imp.	0.07***			–0.11***	–0.04	–0.13***
	(4.07)			(3.91)	(1.38)	(4.28)
Border Dummy	1.01***	1.01***	1.04***	1.00***	0.46**	0.98***
	(7.80)	(7.80)	(7.90)	(7.58)	(2.35)	(7.45)
Trade area Dummy	0.61***	0.61***	0.50***	0.43***	1.16***	0.40***
	(8.49)	(8.49)	(6.82)	(5.75)	(12.29)	(5.32)
Language Dummy	0.40***	0.40***	0.41***	0.39***	0.34*	0.39***
	(4.36)	(4.36)	(4.48)	(4.29)	(1.87)	(4.26)
Colonial Dummy	0.81***	0.81***	0.73***	0.74***	0.52***	0.74***
	(10.35)	(10.35)	(9.47)	(9.57)	(2.94)	(9.56)
Religion Dummy	0.12**	0.12**	0.11**	0.10**	0.13*	0.10**
	(2.53)	(2.53)	(2.22)	(2.12)	(1.76)	(2.13)
Log Population exp.		–0.10***	0.14***			
		(6.39)	(4.92)			
Log Population imp.		–0.07***	0.12***			
		(4.07)	(4.28)			
Instit. quality exporter			0.48***	0.48***		0.51***
			(10.04)	(10.18)		(10.55)
Instit. quality importer			0.37***	0.37***		0.40***
			(8.24)	(8.28)		(8.49)
Institutional distance				–0.06***		–0.04***
				(7.75)		(3.67)
Bilateral importer tariff					–0.37***	
					(8.46)	
Absolute diff. GDP per capita						–0.05**
						(2.45)
Constant	–36.39***	–36.39***	–33.70***	–33.90***	–32.17***	–33.68***
	(93.70)	(93.70)	(76.89)	(77.49)	(47.99)	(75.06)
Observations	13682	13682	13682	13682	4397	13682
Adjusted R-squared	0.68	0.68	0.69	0.69	0.71	0.69
F-statistic	3170.87	3170.87	2636.62	2429.68	971.56	2257.85

Notes: Robust t-statistics in parentheses;* significant at 10%; ** significant at 5%; *** significant at 1%.
Dependent variable: log aggregate bilateral exports.

Our estimates for the first two specifications of Table 4A.1 correspond to these stylized facts. We can also see that both specifications are indeed equivalent and econometrically identical. The third specification adds institutional quality variables to the model. The results indicate that the population coefficients are not robust to this extension. The sign switches from negative to positive, and the effect is statistically significant as well. This is confirmed by the results in column four, which repeats the full specification with institutional variables and per capita GDP for Table 4.3. The negative relation between trade and per capita income points out that rich countries spend less on traded merchandize, all else equal. As argued in the main text, this may reflect that preferences shift towards non-tradables and services, when income levels rise (see Anderson and Marcouiller, 2002). This stands in contrast to the argument that traded goods tend to be income elastic (luxury goods), which would lead to the prediction that expenditure shares of traded goods rise with per capita income. The results support the view that per capita GDP proxies for omitted trade costs variables, in the standard gravity model specification.

It has also been argued that a positive relation between trade and the level of development may reflect that more developed economies have liberalized their trade more (see Frankel, 1997). Therefore, the fifth specification in Table 4A.1 estimates a gravity equation with GDP per capita and bilateral importer tariffs (as used before in Table 4.4), but without institutional variables. Thus, we can check whether the positive effect of per capita GDP is robust to the tariff extension. The results indeed show that the GDP per capita coefficient for the importing country becomes negative afterwards. Import tariffs tend to be lower for rich countries. If tariff levels are not included in the specification, the coefficient on importer per capita income is biased upward, because of this correlation. In other words, GDP per capita levels proxy both institutional and trade policy barriers in the standard gravity equation. As we saw in Table 4.4 of the main text, institutional and trade policy variables have separate effects on bilateral trade, which indicates that each of them captures different barriers to trade.

The final specification in the table includes the absolute difference in (log) per capita incomes, to capture Linder-style preference effects and factor-intensity effects. The negative coefficient provides support for a Linder effect in trade. All else equal, countries with similar levels of GDP per capita tend to trade more. The evidence in support of the Linder effect opens up the possibility that institutional distance had a spurious effect in the gravity equations estimated in the main text. Because institutional quality and per capita income are highly correlated, differences in institutional quality and differences in per capita GDP are related as well. Consequently, the institutional distance variable may just reflect the Linder effect, if the absolute difference in per capita income is omitted from the specification, and vice-versa. Reassuringly, however, the results show that the trade effects of institutional distance and differences in per capita GDP are both robust. The parameter of institutional distance decreases slightly once the Linder effect is controlled for, but both effects remain negative and significant as before. They capture different trade-inducing or trade-resisting characteristics. While institutional distance leads to trade costs due to unfamiliarity with the institutional environment in the trading countries, similarity in GDP per capita is related to similar comparative costs and preferences.

Chapter 5

Institutions, Networks and Trade: An Analysis according to Product Type[1]

5.1 Introduction

Incomplete information on foreign markets and insecurity of property rights and contract enforcement are potentially important intangible barriers to trade (Rauch, 1999; Anderson and Marcouiller, 2002). Search costs are relevant because, in a situation of incomplete information, acquisition of information on product supply and demand is costly, especially for distant and unfamiliar markets. Property security and contract enforcement is problematic in international exchange. Because trade involves multiple legal and political systems, enforcement of contracts is more difficult and transactions are exposed to increased risk of corruption and theft. The effectiveness of formal institutions in securing property and enforcing contracts is a crucial element in determining the risk of exposure to opportunistic behaviour in trade.

In this chapter, we argue that the impact of institutional quality on bilateral trade varies depending on the type of product that is being traded. Because relation-specific search and adjustment costs are higher for transactions in differentiated products, the risk and costs of

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[1] This chapter is based on Linders et al. (2005b). The author is grateful to Uma Subramanian, Jaap de Vries and Andrés Rodríguez-Pose for helpful suggestions and comments on an earlier version of this research. Furthermore, the author thanks Maria Abreu for her comments and help with Stata in dealing with missing or zero-entried trade-flow observations.

exposure to opportunistic behaviour in trade are higher as well. This increases trade costs caused by property and contract insecurity. Distinguishing between homogeneous and differentiated product groups, this chapter estimates gravity equations to investigate how trade patterns are affected by variation in the quality of institutions across countries. The results show that institutions matter most for trade in differentiated goods. This variation in the importance of property security for trade underlines the relevance of search costs and other transaction-specific investments for understanding variation in bilateral trade patterns.

The chapter proceeds as follows. In section 5.2, we discuss more closely the arguments that link unobserved trade costs to search processes and property insecurity in the international market place, and argue that both views are complementary. Section 5.3 gives a brief overview of the data and the empirical model. The empirical results are presented in sections 5.4 and 5.5. Section 5.4 generates estimation results that exclude zero flows in bilateral trade from the sample. Section 5.5 deals with the problems caused by the prevalence, at a disaggregated level, of zero-valued bilateral trade flows. Finally, section 5.6 summarizes the results and discusses the implications.

5.2 The network and insecurity views of intangible barriers to trade

5.2.1 The network view

To understand how trade patterns evolve, recent research points at the importance of networks, rather than atomistic markets (e.g., Rauch, 1999; 2001). The search/network view starts from the observation that a majority of products is not traded on organized exchanges. Therefore, search processes are important in order to match buyers and sellers. Networks serve to facilitate the search for suitable trade partners. As a result, understanding the characteristics and development of networks is important to explain the observed patterns of trade.

Rauch (1999) classifies products according to product type. Homogeneous products differ from differentiated goods in the use of ‘markets’ as opposed to ‘networks’ for exchange. Homogeneous goods can be compared exclusively on the basis of price differences. Several homogeneous products are traded on an organized exchange where supply and demand directly confront and match. Many other homogeneous products are sold on a decentralized market where the 'invisible hand' of the price mechanism takes care of co-ordination. Although not frictionless, matching resembles a perfectly competitive centralized market, where the comparison is based on prices as the only relevant characteristic. For these products, reference prices are often published, illustrating that the price mechanism guides allocation through the possibility for international arbitrage of price differences. Differentiated products cannot be compared on the basis of prices alone. Price differences must be adjusted for differences in characteristics and quality between the varieties. The relative importance of the various characteristics differs across countries depending on the available supply and preferences that prevail (Rauch, 1999, p. 9). In the end, each variety has its own unique blend of characteristics. The product is 'branded', and has its own supplier. Because of the difficulty of comparing differentiated products, differentiated products cannot be traded on organized exchanges.[2] Moreover, information costs are so high that international arbitrage by specialized traders across varieties is not feasible either. Instead, differentiated products are traded through networks by search and match between traders, customers and suppliers. Rauch (1999) argues that the process of search is facilitated by factors that improve the information flow and knowledge of foreign markets. He refers to shared language, colonial links and geographical proximity as search-enabling factors, because they increase bilateral familiarity and decrease 'psychic distance' (see Frankel, 1997).

Rauch (1999) identifies three product groups that reflect the 'network versus market' distinction in trade. Homogeneous products comprise two groups: products traded on an organized exchange and reference-priced articles; the third group consists of differentiated goods. The network theory of trade hypothesizes that search costs are most important for the pattern of trade in differentiated products and least important for organized-exchange

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[2] An organized exchange would not be plausible either, because monopolistic competition prevails in differentiated product industries. Given that a firm is the single supplier of its brand, it will recognize its product's imperfect substitutability and set a price rather than participate in a competitive tâtonnement process.

products. Hence, we expect proximity, language and colonial links to be particularly important for trade in differentiated products.

5.2.2 Insecurity of property and trade

An alternative explanation for unobserved trade costs focuses on variation in institutional effectiveness across countries (see Chapter 2 and Chapter 4). A poor institutional environment, in terms of property rights protection and contract enforceability, entails negative externalities for private transactions and consequently raises transaction costs. As a result, the quality of governance is an important determinant of economic growth and development (see, e.g., Olson, 1996). Institutional economics has recently been extended into the field of international economics (e.g., Dixit, 2004; Anderson and Marcouiller, 2002; Wei, 2000a). This approach states that insecurity of property and contract enforcement imposes high costs on trade. Rodrik (2000, p. 179) argues that the transaction-costs problem of contract enforcement is aggravated for international trade, compared to domestic exchange. International trade involves at least two jurisdictions, which makes contract enforcement more difficult. This discontinuity in the political and legal system increases uncertainty and the risk of opportunistic behaviour by either party to the exchange. Accordingly, the effectiveness of legal and policy systems in providing law and order, securing contract enforcement and facilitating trade is an important determinant of bilateral trade costs.

5.2.3 Complementarity of the search and insecurity views

Network/search theory and institutional theory offer credible explanations for the origin of unobserved trade barriers. The insecurity view argues that bilateral trade will be lower when property is less secure, while network theory stresses the importance of search costs for trade in differentiated products. Both approaches have developed more or less independently. For example, Anderson and Marcouiller (2002, p. 343) indicate that their analysis does not explicitly consider the role of networks in reducing information costs and facilitating trade. Alternatively, Rauch (1999) does not consider the implications of asymmetric information for contract enforcement in trade. However, there is sufficient overlap in the underlying features of both approaches to consider a combination of hypotheses.

The kinship between institutional and network/search theories of trade costs is apparent. Anderson and Marcouiller (2002) note that the insecurity and information-based models overlap "to the extent that information about exposure to misappropriation matters". Amongst others, Rauch (2001), Rauch and Trindade (2002) and Dixit (2004) refer to networks as informal mechanisms to enforce cooperative behaviour. Anderson and Van Wincoop (2004) argue that the effect of ethnic networks on trade found in Rauch and Trindade (2002) can hardly be due to information costs alone. As contracts are often complex and necessarily incomplete, contracting and enforcement costs are likely to be important as well to explain the importance of networks in trade. Informal governance structures, such as networks of business and social relations, substitute for weak formal contract enforcement. The characteristic of networks that enables them to curb opportunistic behaviour has been termed 'closure'. This refers to the existence of sufficient mutual links between network members, in a setting of repeated interaction, such that norms of cooperative behaviour can be propagated, and reneging is signalled and can be sanctioned (Coleman, 1988).

Network closure is easier to accomplish when markets are more or less stable, e.g., in the domestic context (Rodrik, 2000). In global markets, tight networks sometimes lack the openness to new opportunities and trading partners that is needed to widen the scope of trade (Greif, 1994). Historically, tight networks have solved this by migrating to new markets, thereby establishing ethnic links that propagate the network (see, e.g., Rauch and Trindade, 2002; Rauch, 2001). Alternatively, trade networks may expand by focusing on 'weak' ties, which do not focus on kinship or ethnic relations exclusively. Granovetter (1985) referred to the role of weak ties in propagating networks as the 'strength of weak ties'. In general, however, openness comes at a price. It is more difficult to obtain closure by intense mutual ties of repeated interaction in open networks that continuously renew and extend their scope (cf. Dixit, 2004, and Rodrik, 2000). The use of networks focuses more on signalling new opportunities and lowering search costs, instead of acting as tight informal governance structures. The reach of informal governance becomes more limited, which invokes the need for formal institutions to protect property rights. The limits to networks in securing property, however, are complemented by problems to secure trade by more formal legal systems as markets grow larger, most notably when exchange involves multiple jurisdictions. In fact, trade drops dramatically when exchange crosses national borders, which at least partially reflects these problems of governance. This has been documented as the 'border effect' in trade (e.g., McCallum, 1995; see Chapter 2).

Trade relations in differentiated goods tend to be characterized by incomplete contracts, and long-term, repeated interaction. Because of product differentiation, supplier and buyer in general have to engage in specific investments to establish and maintain their relationship. Search costs and product differentiation raise the asset-specific investments that both parties have to incur in trade. In such a situation of bilateral dependencies, repeated interaction can raise incentives for opportunistic behaviour. The risk of opportunism creates the possibility of hold-up problems (see, e.g., Grout, 1984, Van der Ploeg, 1987, and Caballero and Hammour, 1996, for analyses of hold-up problems). Legal and political systems are important to curb the risk of opportunism in trade. International exchange is especially vulnerable to opportunism. Therefore, the effectiveness of the institutional environment is an important determinant of the decision whether or not to invest in bilateral trade relations. Moreover, although networks are arguably less effective as enforcement mechanism on the international market, the risk of opportunistic behaviour still provides a rationale for the importance of selective networks for trade flows, in particular for differentiated goods. For homogeneous products, the risk and costs of opportunistic behaviour are less severe. The trade relation remains 'at arm's length', curbing the costs of opportunistic behaviour by greater possibilities to diversify or substitute away from defectors, due to competitive discipline. Moreover, product homogeneity allows more complete and transparent contracts, which can focus on prices. Still, if the reach of markets extends (across national boundaries), effective enforcement of contracts becomes more difficult for homogeneous products as well (Dixit, 2004).

In this chapter, we investigate whether the impact of institutional quality on bilateral trade depends on the type of product that is being traded. We would generally expect the costs of property insecurity and low contract enforceability to be lowest for organized-exchange products, because diversification is easiest there. Specialized traders can diversify systemic risk of contract breach by ordering from many different suppliers, without any concern left for final customers. For reference-priced commodities, the need for more case-specific search raises search costs and creates an incentive to enter into closer relations. Trade will increasingly avoid environments with low contract enforceability. This leads to a set of hypotheses that resemble those suggested by Rauch (1999) on the relevance of search costs for trade. More specifically, we empirically test whether property rights and contract enforcement institutions are more important for trade in differentiated goods than for trade in homogeneous goods. Inadequate legal and political systems are expected to affect trade patterns most severely for differentiated products, and least so for organized-exchange products. Moreover, just as colonial and language links facilitate search, they are also likely to increase traders' skills to operate effectively in each other's institutional settings (Anderson and Marcouiller, 2002). This provides an additional reason to expect a higher effect from historical links on trade in differentiated products.

The remainder of this chapter investigates these hypotheses more closely by estimating institutions-augmented gravity equations to explain bilateral trade in differentiated, reference-priced and organized-exchange commodities. The next section discusses the data and the empirical gravity model.

5.3 Data and method

In order to identify whether the impact of variation in institutional quality varies according to the type of product traded, we estimate gravity equations on trade flows disaggregated by product group.

The benchmark version of the disaggregated gravity equations estimated below looks as follows:

$$\begin{aligned}\ln(T_{ij}^{k}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(y_i) + \beta_4 \ln(y_j) + \beta_5 \ln(D_{ij}) + \beta_6 Adj_{ij} \\ + \beta_7 RIA_{ij} + \beta_8 Lan_{ij} + \beta_9 Col_{ij} + \beta_{10} Rel_{ij} + \beta_{11} IQ_i + \beta_{12} IQ_j + \beta_{13} ID_{ij} + \varepsilon_{ij}\end{aligned}, \quad (5.1)$$

where i and j denote the exporting and importing country, respectively. The dataset comprises 119 countries (listed in the Data Appendix). The dependent variable T_{ij}^{k} is merchandise exports (in '000 US$) from i to j in product group k, for 1998. The independent variables are, as in Chapter 4: GDP (Y), GDP per capita (y), the distance between i and j (D_{ij}) and dummies reflecting whether i and j: share a land border (*Adj*), are both member in a regional integration agreement (*RIA*), have the same primary language (*Lan*) or main religion (*Rel*), and whether they were part of a common colonial empire (*Col*).[3]

The Data Appendix provides more information on the data sources and a more comprehensive discussion of these variables. The data on disaggregate bilateral trade warrant some additional remarks. We have collected bilateral trade data at the macroeconomic level, as well as disaggregated by product type. The disaggregate classification according to product type has been developed by Rauch (1999). He classified 5-digit SITC items according to whether they are traded on organized exchanges, have listed reference prices (for example, price quotations in trade journals), or have none of these features and are consequently classified as differentiated goods.[4] International trade figures are generally reported at most at the 3- and 4-digit SITC level. In order to classify these levels of aggregation according to the above trichotomy, the category accounting for the largest share of the value of world trade in the respective 3- or 4-digit SITC (sub-)group was assigned to it. Because the World Trade

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[3] Note that the analysis in this chapter applies to trade in 1998, instead of 1999. Therefore, GDP and per capita GDP also apply to 1998. The data on institutional quality are for 1998 in all chapters in the empirical analyses of Part II.

[4] If products do not have listed reference prices and are not traded on a centralized market, we can assume that comparing products only on price levels is not sufficient for these goods. As a result, it makes no sense to centralize trade or publish price quotations. These products have to be compared along multiple dimensions: they are differentiated.

Database, used by Rauch (1999) for international trade data, does not report trade by 5-digit SITC, he made use of data from the U.S. Department of Commerce. This results in a classification of trade according to product type at the 3- and 4-digit SITC level. Because the aggregation from the 5-digit level to 3- or 4-digit SITC sometimes led to some ambiguity concerning which product type would best represent the underlying 5-digit commodities, Rauch has distinguished a 'conservative' and a 'liberal' classification. The first mentioned classification minimizes the number of sectors that is classified as either organized exchange or reference priced at the 3- and 4-digit commodity level; the last mentioned classification maximizes these numbers.[5]

The analysis below makes use of the conservative classification. Because of its reluctance to classify sectors as consisting of homogeneous products, we build in a security margin against our main empirical hypotheses. It becomes more difficult to validate the hypothesis that, for example, institutional quality is most important for trade in differentiated goods and least important for trade in organized-exchange goods, because sectors that might potentially classify as reference priced or organized exchange in the liberal classification are classified as differentiated and reference priced, respectively, in the conservative classification. Table 5.1 reports the trade levels and shares of total bilateral exports in the sample, for each of the product groups distinguished by Rauch (1999).

Like in Chapter 4, the variables of particular interest deal with the institutional framework.[6] The first two reflect the level of subjective institutional quality (*IQ*) in both countries. Finally, the last regressor variable (*ID*) reflects bilateral distance between the institutional settings, in terms of their effectiveness. The last term is the stochastic error term, which captures all other (omitted) effects on trade and is assumed to be well behaved.

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[5] The classification in product categories is available at Jon Haveman's data website (see the Data Appendix).

[6] Apart from the introduction of institutional factors, the specification adopted closely resembles that in Rauch (1999). Some additional differences exist, though. Our specification separates the influences of language and colonial ties, and adds cultural links as expressed in the main religion adhered to.

Table 5.1 An overview of trade per product group

Product Group	Trade (bln. US$, 1998)	Trade (% share)
Organized exchange:		
- Total	319.01	6.9
- Excl. petroleum products	196.32	4.3
Reference priced	607.76	13.2
Differentiated goods	2158.41	46.8
Non-classified*	1527.22	33.1
Bilateral exports (sample total)	4612.40	100.0

Note: Not all trade flows could be classified, because the classification scheme does not include all 2-, 3- or 4 digit codes.

For data on the quality of governance systems, we use the database constructed by Kaufmann et al. (2003), as in Chapter 4. They have constructed six indicators of perceived institutional quality. Each indicator captures a different aspect of governance. These indicators have been described in detail in Chapter 4. Here we briefly mention them again:

1. Voice and Accountability
2. Political stability
3. Government effectiveness
4. Regulatory quality
5. Rule of law
6. Control of corruption.

As explained in Chapter 4, we have aggregated the six indicators into a composite measure of institutional quality. The arithmetic average of the separate indicator scores serves as the composite indicator. Similarly, we use the Kogut-Singh indicator of institutional distance, reflecting bilateral distance in terms of institutional effectiveness, introduced in Chapter 4 (cf. Kogut and Singh, 1988):

$$ID_{ij} = \frac{1}{6}\sum_{k=1}^{6}\left(I_{ki} - I_{kj}\right)^2 \Big/ V_k \, , \tag{5.2}$$

where I_{ki} indicates the score of country i on indicator k, and V_k stands for the variance of indicator scores across all countries in the sample.

5.4 Empirical results: excluding zero flows

The following two sections investigate whether the impact of variation in institutional quality on trade patterns varies across different categories of products, depending on the extent of product differentiation. Section 5.4 confines the estimations to the observations with positive bilateral trade flows only. Section 5.5 implements two different approaches to deal with the effect of zero flows on the comparison across product groups. We estimate gravity equation (5.1) for both aggregate bilateral trade and trade according to product type, using OLS. Table 5.2 presents the results.

Specification (1) reports the results for aggregate bilateral trade. The findings confirm the well-established result that trade positively depends on GDP and negatively on distance. The results for aggregate bilateral trade correspond to the findings in the previous chapter. The relation between institutional quality and trade is positive and significant, both from the export and import side. Institutional distance negatively affects bilateral trade. The effect of GDP per capita is negative once the model includes institutional quality variables.

The other specifications in the table present the estimates for organized-exchange products, reference-priced goods and differentiated products, respectively. A separate column reports the gravity estimates for bilateral trade patterns in organized-exchange products excluding petroleum from the group. This serves as a robustness check on the results for organized-exchange products. Petroleum products account for a large share of total trade in this group, while it has often been indicated that trade flows reported for this industry are prone to suffer from false reporting and misreporting (see Rauch, 1999, footnote 7).

Table 5.2 Gravity equations by product group, for non-zero observations

	(1) Aggregate Trade	(2) Organized exchange	(3) Org. exch. (ex. petroleum)	(4) Reference priced	(5) Differentiated goods
Log GDP exporter	1.19***	0.96***	0.96***	1.03***	1.28***
	(87.00)	(41.82)	(42.60)	(58.80)	(88.56)
Log GDP importer	0.94***	0.98***	0.95***	0.87***	0.82***
	(70.24)	(40.72)	(41.00)	(50.48)	(56.66)
Log Distance	–1.20***	–1.00***	–0.93***	–1.22***	–1.34***
	(49.47)	(25.13)	(24.22)	(41.14)	(52.13)
Log GDP/cap exp.	–0.20***	0.05	–0.12**	0.08*	–0.16***
	(6.19)	(0.93)	(2.20)	(1.74)	(4.60)
Log GDP/cap imp.	–0.06*	–0.07	–0.05	–0.07*	–0.04
	(1.90)	(1.23)	(0.90)	(1.89)	(1.24)
Border Dummy	0.85***	1.05***	1.20***	0.97***	0.87***
	(6.00)	(6.32)	(7.51)	(6.39)	(6.26)
Trade area Dummy	0.56***	0.87***	0.77***	0.82***	0.55***
	(7.20)	(7.94)	(7.27)	(9.34)	(7.11)
Language Dummy	0.44***	0.35**	0.30*	0.38***	0.60***
	(4.49)	(2.08)	(1.82)	(3.18)	(5.97)
Colonial Dummy	0.61***	0.68***	0.67***	0.59***	0.49***
	(7.25)	(4.81)	(4.84)	(5.71)	(5.64)
Religion Dummy	0.18***	–0.16*	–0.16*	–0.04	0.13**
	(3.53)	(1.83)	(1.89)	(0.67)	(2.47)
Instit. quality exporter	0.62***	–0.40***	0.11	0.27***	0.85***
	(11.86)	(4.42)	(1.22)	(4.00)	(15.09)
Instit. quality importer	0.31***	0.03	–0.04	0.14**	0.39***
	(6.37)	(0.35)	(0.55)	(2.36)	(7.64)
Institutional distance	–0.05***	–0.05***	–0.10***	–0.13***	–0.09***
	(4.97)	(3.18)	(6.35)	(11.08)	(8.98)
Constant	–31.90***	–33.41***	–32.32***	–29.93***	–31.81***
	(70.92)	(40.44)	(40.22)	(50.49)	(66.71)
Observations	11875	6877	6815	9008	11059
Adjusted R-squared	0.69	0.42	0.43	0.57	0.70
F-statistic	2085.07	456.64	475.05	1042.28	2176.56

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log bilateral exports.

We first note that the hypotheses of Rauch (1999) are mostly supported by these results. The distance effect on trade indeed is more important for differentiated goods than for homogeneous goods, and furthermore least important for organized-exchange products.

Language and religious links, as proxy for cultural familiarity and psychic distance between countries, enhance trade most for differentiated products as well. The estimated effect of a common religion on trade is even significantly negative for products that are traded on an organized exchange. Colonial history, however, seems to be less important for differentiated than for homogeneous goods. The relative importance of colonial history for bilateral exports of homogeneous goods seems to contrast with Rauch's expectations. However, homogeneous products relatively frequently classify in basic industries, such as steel or resource extraction (Feenstra et al., 2001). Countries with comparative advantages in those industries include formerly colonized developing countries. Hence, the influence of resource-rich ex-colonies may explain why colonial links are relatively important for trade in homogeneous goods. Common membership in a free trade area promotes trade most in homogeneous goods. This may reflect that trade in homogeneous goods is more sensitive to price differences than trade in heterogeneous goods.

The results support the view that institutions matter most for trade in differentiated goods. The estimated positive effect of institutional effectiveness in protecting property and securing trade is highest for differentiated products. Some regression parameters for institutional quality in organized-exchange commodities are insignificant or negative, sometimes even statistically significantly so. Especially when petroleum products are included in the organized-exchange group, the underlying mechanisms reflected by GDP per capita and institutions appear to be difficult to disentangle, given that they are highly correlated. Particularly for the organized-exchange group, GDP per capita may also reflect the effects of comparative costs differences on trade patterns. The findings may reflect the prominence of low governance-quality developing countries among exporters of these commodities. For differentiated goods and reference-priced homogeneous commodities, the estimates for both GDP per capita and institutions are more in line with the aggregate pattern. These latter product groups are more diverse in their composition, and thus more likely to include products in which comparative advantages are located in low-income countries and other products that are based more in capital rich high-income countries. Still, the estimate on exporter GDP per capita for reference-priced products suggests that comparative costs differences still have an effect on the aggregate composition of trade patterns in this type of products. The effect of institutional distance on the intensity of bilateral trade is negative, which is likely to be due to increased transaction costs caused by widely differing institutional settings (see Chapter 4). However, this effect does not seem to be more important for differentiated goods; if anything, it seems slightly more important for reference-price goods.

5.5 Empirical results: dealing with the presence of zero flows

So far, the regression analysis considered country-pair observations with positive trade flows only. A double-logarithmic formulation of the gravity model, as in equation (5.1), cannot include zero trade, because the logarithm of zero is undefined. However, in our data set of bilateral trade, some of the potential trade flows are recorded as zero or missing.[7] At the aggregate level, zero flows mostly occur for small and distant countries, which are expected to trade little (Frankel, 1997). The presence of zero or missing trade is more frequent when we focus on disaggregated trade. It turns out that omission of zero flows from the set of observations restricts the regression sample differently across different product types. The number of zero-entried observations is largest for trade in the organized-exchange group of products. Zero flows are observed less frequently in the reference-priced group, but they still occur more often than in differentiated products.

[7] Most of these flows are recorded as missing in the source database (UN COMTRADE); some have explicitly been recorded as zero. We assume that all missing observations in principle indicate that bilateral exports are considered to be absent by the reporting country. Countries that do not report any trade statistics in the database have been omitted from our sample. As described in the Data Appendix, we have confronted flows from country i to j as reported by both countries to check for reporting errors in missing flows. Apart from flows that are truly zero, missing trade may also reflect imperfections in measurement as a consequence of rounding processes. Trade flows can be too small to register if reporting of trade involves rounding to the nearest integer amount of predetermined size (e.g., rounded to thousands of US$; this would imply that trade is censored from below at US$ 500). However, the data do not appear to be generally censored below a fixed amount, as flows have been reported as low as US$ 1.

If they do not occur randomly, omitting zero-entried observations implies we loose information on the causes of (very) low trade. This potentially causes bias in the regression estimates. Specifically, if geographic distance, a lack of cultural or historical links and ineffective institutions lead to lower trade, omitting zero flows tends to reduce the estimated effects of these transaction costs on trade (cf. Rauch, 1999). Consequently, differences in the share of zero flows may affect the comparability of results across product groups. In order to check the comparability of regression results, we have estimated equation (5.1) for a balanced sample of non-zero flows across product groups. The results are discussed in the next sub-section. Subsequently, section 5.5.2 explicitly includes the zero-trade observations in the empirical analysis of bilateral trade patterns. The details of that approach are presented in Appendix 5A.

5.5.1 Results for a balanced sample of non-zero observations

As a first correction for the effect of omitting zero flows, Table 5.3 presents the regression results after we have constructed a balanced sample of non-zero observations across sectors. The analysis considers only those observations (6336, in total) for which trade is non-zero in all product categories. This implies that the bias resulting from the omission of zero flows is roughly equal for each sector. This ensures that the results across product groups are comparable. Moreover, using a balanced sample allows us to draw statistical conclusions about the differences in parameter estimates between product groups.

Starting from a balanced sample, a sampling effect shows up clearly with respect to the distance effect on trade. Because the number of zero flows was most restrictive for organized-exchange goods, the balanced sample more closely resembles the non-zero sample of those goods. Due to the reduced presence of low (but positive) trade values in the balanced sample for differentiated and reference-priced goods, the estimates on the distance effect are much closer across sectors.

Table 5.3 Gravity equations by product group: balanced sample

	(1) Aggregate Trade	(2) Organized exchange	(3) Org. exch. (ex. petroleum)	(4) Reference priced	(5) Differentiated goods
Log GDP exporter	0.91***	1.01***	1.00***	0.99***	1.11***
	(67.92)	(42.72)	(43.09)	(49.80)	(67.30)
Log GDP importer	0.76***	1.02***	0.99***	0.85***	0.70***
	(58.53)	(42.10)	(41.92)	(44.74)	(45.11)
Log Distance	–0.86***	–1.07***	–1.00***	–1.19***	–1.10***
	(40.94)	(26.65)	(25.62)	(39.14)	(41.78)
Log GDP/cap exp.	–0.01	0.15**	–0.02	0.13***	–0.07*
	(0.45)	(2.55)	(0.36)	(2.66)	(1.69)
Log GDP/cap imp.	–0.01	–0.06	–0.03	–0.05	0.03
	(0.26)	(1.05)	(0.50)	(1.09)	(0.95)
Border Dummy	0.71***	1.06***	1.17***	0.93***	0.70***
	(6.53)	(6.37)	(7.33)	(6.38)	(5.68)
Trade area Dummy	0.68***	0.87***	0.78***	0.73***	0.54***
	(11.84)	(7.93)	(7.34)	(8.57)	(8.07)
Language Dummy	0.33***	0.30*	0.26	0.31***	0.44***
	(3.86)	(1.74)	(1.58)	(2.63)	(4.26)
Colonial Dummy	0.53***	0.76***	0.71***	0.74***	0.50***
	(7.03)	(5.27)	(5.02)	(6.92)	(5.51)
Religion Dummy	–0.00	–0.15	–0.16*	–0.02	0.01
	(0.07)	(1.64)	(1.92)	(0.28)	(0.22)
Instit. quality exporter	0.12**	–0.53***	–0.07	0.14*	0.50***
	(2.52)	(5.55)	(0.76)	(1.84)	(7.67)
Instit. quality importer	0.15***	–0.00	–0.09	0.06	0.20***
	(3.61)	(0.04)	(1.12)	(0.97)	(3.83)
Institutional distance	–0.05***	–0.06***	–0.10***	–0.11***	–0.09***
	(5.62)	(3.31)	(6.15)	(8.86)	(7.86)
Constant	–24.06***	–36.22***	–34.79***	–29.11***	–27.24***
	(52.73)	(42.80)	(42.24)	(43.69)	(48.55)
Observations	6336	6336	6336	6336	6336
Adjusted R-squared	0.70	0.44	0.44	0.58	0.67
F-statistic	1081.94	459.21	468.01	684.65	932.58

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log bilateral exports; non-zero flows only.

Still, an *F*-test on the difference in parameter estimates across product groups shows that distance is significantly more important for trade in differentiated and reference-priced goods than for organized-exchange products (excl. petroleum).[8] Surprisingly, the estimated distance

[8] An *F*-test on equality of coefficients rejects the null hypothesis of equal coefficients on distance with a *p*-value of 3.3% (0.00%) for differentiated (reference-priced) goods compared to non-petroleum organized exchange products. These results were generated in Stata, using the mvreg-procedure (multivariate regression) to estimate the gravity equations for all three groups as a multiple-equation regression model. This allows us to statistically test for the equality of regression coefficients across the different equations.

effect for reference-priced products is larger than for differentiated goods. Statistically, the distance effect differs significantly between differentiated and reference-priced goods (at a *p*-value of 0.32%). The comparison of distance effects in the balanced sample thus provides less support for the search-costs view, specifically on (the role of) differences in these costs between reference-price versus differentiated products.

The general conclusions, when comparing the effects of language and colonial links and institutions across sectors, resemble those for the unbalanced sample (see Table 5.2). Sharing a common language appears to benefit trade in differentiated products most, though its parameter estimate has declined in size due to the sampling effect. However, the differences in language effect between differentiated products and both organized-exchange goods and reference-price products are not statistically significant (*p*-values of 31% and 32%, respectively). Although the differences in effect sizes are large, differences between product groups in the statistical significance of the language parameter and overall fit of the model (reflected by the adjusted R-squared) reduce the statistical significance of these cross-equation parameter differences. As in the unbalanced sample, colonial links appear to be more important for trade in homogeneous products than for differentiated products. This conclusion is supported statistically for the reference-price group (at a *p*-value of 2.6%), but not for organized-exchange goods (*p*-value of 16%). As before, colonial links provide no support for expected *differences* in search costs across product types. Moreover, the effect on trade of cultural links captured by religious similarity only offers weak support for the network view in the balanced sample. Thus, for the balanced sample, the evidence with respect to the network/search cost hypothesis is mixed, especially regarding the difference in trade costs between reference-priced and differentiated goods.

In contrast, the results in Table 5.3 confirm the hypothesis that institutions matter most for differentiated products and least for products traded on an organized exchange. Although the effect size of institutional quality falls for both reference-price and differentiated product groups (compared to the results for the unbalanced sample in Table 5.2), the effect on trade generally remains significantly positive. The pattern for organized-exchange goods is more diffuse, as in Table 5.2. The difference in the effect size, for exporting and importing country institutional quality, between (non-petroleum) organized-exchange goods and reference-priced goods is statistically significant at 10% at least (*p*-values of 2.4% and 7.7%, respectively). For the comparison between differentiated products and organized-exchange goods, the set of corresponding *p*-values is 0.00% and 0.08%, respectively. The estimates for differentiated products differ significantly from reference-priced products as well (at *p*-values of 0.00% for exporter institutions, and 2.8% for importer institutions). Differences in the effect of institutional distance across sectors are rejected statistically for differentiated versus non-petroleum organized-exchange goods (*p*-value of 38%). The test outcomes statistically confirm that institutional distance may be slightly less important for trade patterns in the differentiated product group than for reference-priced goods (*p*-value of 5.5%).

As in Chapter 4, fixed effects estimations serve to check the robustness of the regression results for potential country-specific omitted variables bias. For the balanced sample of non-zero observations, Table 5.4 presents fixed-effects estimations of the gravity equation. The first three specifications include exporter-specific fixed effects for each of the product groups. The basic explanatory variables in the gravity equation may be different in nature at the disaggregate level of trade. Particularly at the export side of the gravity equation, GDP may be less suited to capture trade potential, because of the relevance of specialization patterns in production at a disaggregated level. At the import demand side, GDP still measures market size (and trade potential) relatively accurately. This motivates the focus on exporter-specific fixed effects in the first part of Table 5.4. Moreover, importer-specific institutional quality can remain in the model, which allows us to consider the differences in its effect across product groups. The remaining specifications add country dummies on the import side as well. In this fully specified fixed-effects model, the effect of comparative advantages and specialization in production on import demand has been taken care of as well. The drawback of this specification is that we have to drop the institutional quality variables altogether. Table 5.4

presents the results for three product groups, in which organized-exchange products exclude petroleum.

Table 5.4 Robustness: country-specific effects in a balanced sample

	Exporter-specific effects:			Full set of country-specific effects:		
	(1) Org. exch. (excluding petroleum)	(2) Reference priced	(3) Different. goods	(4) Org. exch. (excluding petroleum)	(5) Reference priced	(6) Different. goods
Log GDP importer	1.05***	0.90***	0.73***			
	(47.82)	(54.04)	(55.25)			
Log Distance	–1.42***	–1.23***	–1.07***	–1.47***	–1.43***	–1.16***
	(31.28)	(35.98)	(39.48)	(26.75)	(34.28)	(35.41)
Log GDP/cap imp.	–0.09*	–0.07**	0.00			
	(1.90)	(2.03)	(0.07)			
Border Dummy	0.85***	0.97***	0.87***	0.89***	0.92***	0.82***
	(4.95)	(7.47)	(8.41)	(5.27)	(7.20)	(8.20)
Trade area Dummy	0.26**	0.63***	0.58***	0.17	0.36***	0.41***
	(2.23)	(7.29)	(8.33)	(1.32)	(3.67)	(5.37)
Language Dummy	0.36**	0.39***	0.70***	0.56***	0.25**	0.60***
	(2.30)	(3.26)	(7.35)	(3.48)	(2.05)	(6.23)
Colonial Dummy	0.61***	0.87***	0.57***	0.45***	0.70***	0.46***
	(4.42)	(8.39)	(6.87)	(3.07)	(6.36)	(5.28)
Religion Dummy	–0.04	0.23***	0.30***	0.04	0.19***	0.29***
	(0.46)	(3.43)	(5.51)	(0.40)	(2.73)	(5.15)
Instit. quality importer	–0.03	0.10*	0.25***			
	(0.35)	(1.81)	(5.51)			
Institutional distance	–0.09***	–0.11***	–0.06***	–0.08***	–0.12***	–0.09***
	(5.48)	(9.28)	(5.72)	(4.35)	(8.82)	(8.36)
Constant	–10.63***	–8.92***	–5.58***	10.70***	11.14***	10.43***
	(13.71)	(15.26)	(11.97)	(12.88)	(17.65)	(21.03)
Observations	6336	6336	6336	6336	6336	6336
Adjusted R-squared	0.53	0.66	0.75	0.56	0.68	0.77
F-statistic	56.34	96.24	149.79	34.40	55.67	89.09

Notes: Absolute value of t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log bilateral exports; non-zero flows only.

Compared to Table 5.3, there are some interesting changes in results, regarding the search-costs variables. First, the distance effect now clearly tends to be higher for homogeneous goods.[9] Including both import and export country dummies, the effect is quite similar for both

[9] Note, that the contiguity effect does not differ much between sectors in the fixed-effects specifications. In Tables 5.2 and 5.3, the estimated effect was larger for homogeneous goods than for differentiated goods. This already suggested that proximity was more important for homogeneous goods trade than suggested by the distance effect estimates in those tables. Fixed effects correct for omitted variables bias on both the distance and the border effect.

sub-categories of homogeneous goods. The evidence on language effects is mixed. In the specification with exporter-specific fixed effects, language is clearly most important for trade in differentiated products. In the full fixed-effects specification, this conclusion only holds firmly compared to reference-priced products. Regarding the effect of colonial links, the results still suggest a higher importance for reference-price products, but the effect no longer differs systematically between differentiated and organized-exchange goods. Finally, the estimates for common religion now have the expected sign and are consistent with the prior expectations of the network/search costs view.

Concerning the insecurity-costs hypotheses, the conclusions appear to be robust. Institutional quality matters most for trade in differentiated products and least for arm's length trade on organized exchanges, whereas institutional distance tends to affect trade in reference-priced products slightly more than trade in the other product groups. Finally, it is worth noting the difference in results for another trade costs variable, which is not directly linked to the hypotheses in this chapter. In contrast with the previous tables, the results in Table 5.4 indicate that common membership in a regional integration bloc influences trade more in differentiated and reference-priced goods, compared to the organized-exchange group. This suggests that the parameter estimate on trade preferences in the standard specification of the gravity equation suffers from omitted variables bias, particularly for the organized-exchange product group.

5.5.2 Results including zero flows in the sample

We have mentioned before that the occurrence of zero flows can bias the empirical results. Rauch (1999) argues that disregarding zero flows leads to an under-estimation of the impact of distance and historical and cultural links on trade, "[i]f zero observations tend to occur between countries that are far apart and do not share a common language/colonial tie" (pp. 18–19). A similar reasoning holds for the effect of institutional quality on trade patterns.

Several approaches have been applied or suggested in the literature to address the problem of zero flows (see, e.g., Frankel, 1997, pp. 145–146; Bikker, 1982, pp. 371–372). The most common solution in the literature confines the sample to non-zero observations to avoid the estimation problems related to zero trade. However, the omission of zero flows can give rise to biased results. The zero-valued flows contain relevant information about the pattern of trade. Throwing away zero entries implies that one loses any information contained in these flows on why these low levels of trade are observed (Eichengreen and Irwin, 1998, p. 41). Alternatively, (part of the) zero values may be substituted by a small constant, so that the double-log model can be estimated without throwing these country pairs out of the sample. Substituting small values prevents omission of observations from the sample, but is essentially ad hoc. The inserted value is arbitrary and does not necessarily reflect the underlying expected value. Thus, inserting arbitrary values close to zero does not provide any formal guarantee that the resulting estimates of the gravity equation are consistent. Both approaches are hence generally unsatisfactory.

Since for our purposes small and zero-valued trade flows are more common than at the aggregate level, it is of particular interest to assess the effect of including zero flows. Dealing properly with zero flows, then, would involve that the information provided by these flows is taken into account, without using ad-hoc methods. The censored regression model (Tobit model) is often employed to analyse data sets in which a substantial fraction of the observations cluster at the (zero-) limit. The Tobit model describes a situation in which part of the observations on the dependent variable is censored (unobservable) and represented instead by mapping them to a specific value, generally zero. The model applies to situations in which outcomes cannot be observed over some range, either because actual outcomes cannot reflect desired outcomes (e.g., actual trade cannot be negative), or because of measurement inaccuracy (e.g., rounding). Thus, whether the Tobit model can be applied to study zero flows in the conventional gravity framework depends on two questions. First, ‘Can desired trade be negative?’ and second, ‘Is rounding of trade flows an important concern?’.

The gravity model, in its conventional specification, does not explain the occurrence of zero-flow observations. This can be illustrated by considering the gravity model in levels, rather than logs. Equation (5.3) presents a typical specification of the gravity model, with explanatory variables GDP (*Y*), geographic distance (*D*), and a set of variables (*x*) that includes institutional variables as well as the bilateral dummy variables, under the assumption of a log-normally distributed disturbance term.

$$T_{ij} = AY_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{-\beta_3} e^{x'_{ij}\gamma_k} e^{\varepsilon_{ij}} \,. \tag{5.3}$$

As can easily be seen, the gravity model as conventionally specified would only predict zero trade if the GDP of one or both countries equaled zero. This is only a hypothetical situation, of course, which will not occur in practice.[10] If we specified equation (5.3) with an additive, normally distributed error term, instead of a log-normal error structure, the gravity model could in principle generate negative trade, by means of the random error. This negative trade would then be censored at zero, and actual zero trade might reflect desired negative trade. Note, however, that the predicted, non-stochastic part of the gravity model can never be negative. Given that the non-stochastic part can be derived from economic optimization, it is unclear which optimizing framework would justify negative desired trade, even if caused by randomly distributed factors not explicitly identified in the model.[11] The first question can thus be answered negatively.

If trade flows were rounded to zero below some censoring value, the Tobit model might be useful to estimate the gravity equation. Usually, the gravity model is restated in terms of natural logarithms for the purpose of estimation.

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[10] One could imagine this to describe the tautological situation of trade with an uninhibited island, which would be zero almost per definition.

[11] In fact, this implies that an additive error term might better be regarded as truncated from below. Zero flows then always represent desired zero flows, and the model is consistent with economic optimization. However, this solution does not accord with the Tobit model anymore.

The censoring model, given that rounding occurs at some positive fixed value (a), would then look as follows:

$$\begin{aligned} &\ln(\tilde{T}_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) - \beta_3 \ln(D_{ij}) + x_{ij}'\gamma + \varepsilon_{ij} \\ &\ln(T_{ij}) = \ln(\tilde{T}_{ij}) \quad \text{if } \ln(\tilde{T}_{ij}) > \ln(a) \\ &\ln(T_{ij}) = \ln(a) \quad \text{if } \ln(\tilde{T}_{ij}) \le \ln(a) \end{aligned} \quad . \qquad (5.4)$$

In this formulation, censoring at zero trade (a=0) also causes technical problems because the logarithm of zero is not defined. Though censoring cannot occur at zero, it can occur at some positive fixed value (a), as shown in equation (5.4), due to rounding. However, rounding of trade flows in general does not seem to occur in our data set. As noted before, trade flows are reported up to an accuracy of US$ 1 (although this differs somewhat across countries).

Given that the conventional gravity model (5.3) is not capable to generate zero-valued bilateral trade nor desired negative trade, and in the absence of rounding below some positive value, zero flows have to be interpreted otherwise. In this context, zero flows result from binary decision making rather than censoring (Sigelman and Zeng, 1999). The appropriate way to proceed, then, is "to model the decisions that produce the zero observations rather than use the Tobit model mechanically" (Maddala, 1992, cf. Sigelman and Zeng, 1999, p. 170). This can be done by modelling the decision whether or not to trade as a Probit model. The outcome of that decision determines whether or not we observe actual trade flows in the sample, or trade is zero (or, equivalently, missing). The size of potential trade is determined by the gravity model. We only observe positive trade in case the selection model resulted in a positive outcome. This structure has been framed in the sample selection model (see, e.g., Greene, 2000, section 20.4; Verbeek, 2000, section 7.4). The selection model is often used in micro-econometric research, especially in labour economics. Its use can be traced back, for example, to Gronau (1974). A rather small number of gravity model studies of bilateral trade have used the selection model to deal with zero flows. For example, Bikker (1982) and Bikker and De Vos (1992) make extensive use of a selection model, similar to the one used here. Rose (2000) estimates a variant of the model in a robustness section of the paper, without explicating the model. Hillberry (2002) motivates and estimates a more restricted variant, in which an independent selection and (truncated) regression equation are estimated (cf. Cragg, 1971). The sample selection model of bilateral trade that we will use is:[12]

Selection mechanism:

$$\tilde{\pi}_{ij} = \gamma_0 + \gamma_1 \ln(Y_i) + \gamma_2 \ln(Y_j) + \gamma_3 \ln(y_i) + \gamma_4 \ln(y_j) + \gamma_5 \ln(D_{ij}) + \gamma_6 Adj_{ij}$$
$$+\gamma_7 RIA_{ij} + \gamma_8 Lan_{ij} + \gamma_9 Col_{ij} + \gamma_{10} Rel_{ij} + \gamma_{11} IQ_i + \gamma_{12} IQ_j + \gamma_{13} ID_{ij} + \mu_{ij}$$
$$s_{ij} = 1 \text{ if } \tilde{\pi}_{ij} > 0$$
$$s_{ij} = 0 \text{ if } \tilde{\pi}_{ij} \leq 0$$

Regression model:

$$\ln(\tilde{T}_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(y_i) + \beta_4 \ln(y_j) + \beta_5 \ln(D_{ij}) + \beta_6 Adj_{ij} \qquad (5.5)$$
$$+\beta_7 RIA_{ij} + \beta_8 Lan_{ij} + \beta_9 Col_{ij} + \beta_{10} Rel_{ij} + \beta_{11} IQ_i + \beta_{12} IQ_j + \beta_{13} ID_{ij} + \varepsilon_{ij}$$

$$\ln(T_{ij}) = \ln(\tilde{T}_{ij}) \text{ if } s_{ij} = 1$$
$$\ln(T_{ij}) = \text{not observed if } s_{ij} = 0$$

$$(\mu_{ij}, \varepsilon_{ij}) \sim \text{bivariate normal}[0,0,1,\sigma_\varepsilon^2,\rho_{\varepsilon\mu}]$$

The selection equation determines whether or not we observe bilateral trade between two countries in the sample. The regression model determines the potential size of bilateral trade. In general, the selection equation should at least contain all variables that are reflected in the regression equation (Verbeek, 2000). We assume that the selection process reflects decisions made at the microeconomic level on the basis of comparing costs and benefits of bilateral transactions (see Bikker and De Vos, 1992). Anderson and Van Wincoop (2004) point at the

[12] In Appendix 5B, we will also discuss some alternative approaches that are often used to deal with zero flows. Several Tobit estimates, truncated regression and substitutions for zero flows are presented. These results compare unfavourably with the selection model below, because they are theoretically unsuited for the situation at hand.

importance of fixed costs associated with international trade, such as border costs (Hillberry, 2002), search costs and other specific investments (as well as related insecurity costs, as in the context of section 5.2) to explain zero flows in trade. At the macroeconomic level, we may assume an underlying latent variable, say profitability, which depends on the same variables as the gravity equation. This can be motivated by the fact that profitability will generally rise if the potential size of trade gets larger. However, this does not imply that profitability only reflects the potential size of the flow. For example, some variables may be more important in determining the profitability of flows rather than the potential size of these flows. Moreover, the disturbance term of the selection equation will capture all (microeconomic) factors that influence profitability of bilateral transactions. Therefore, we expect that the coefficients in the selection and regression equation will not perfectly match and that the correlation between the disturbance terms will be positive, but not necessarily one.[13]

The basic idea behind the sample selection model is as follows. If a variable, such as institutional quality, becomes so low that firms decide to stop exporting to a country because it is no longer profitable, we do not observe (potential) bilateral trade. Therefore, the effect of low institutional quality could be underestimated from the available data (cf. Verbeek, 2000, p. 207). The effect would be underestimated if the correlation between the disturbance terms of both equations in the model is positive, in this case. Those trade flows that we do observe for low institutional quality levels will have a positive expected value for the disturbance term

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[13] As noted by Bikker and De Vos (1992), for $\gamma_k = \beta_k / \sigma_\varepsilon, k \in \{1,..K\}$, $\gamma_0 = (\beta_0 - \ln(a)) / \sigma_\varepsilon$ and $\rho_{\varepsilon\mu} = 1$, the sample selection model transforms into the Tobit model in equation (5.4) (see also Verbeek, 2000 and Greene, 2000 for similar observations for the standard Tobit model). The only difference with equation (5.4) is that the selection equation has a variance normalized to one and includes a linear transformation with the censoring threshold, because the selection limit is set at zero. Because, in the Tobit model, the latent selection variable and the potential size of the action are perfectly correlated, we can map the latent variable to the observed variable and do not need to normalize the selection equation. This leads to the formulation of the observation rule in equation (5.4) (with the exception, not of importance to estimation, that equation (5.4) sets all missing observations equal to $\ln(a)$). Note that, if the estimated sample selection model would (approximately) lead to the stated relations regarding parameters and cross-equation correlation, we would observe trade *as if* it were censored at a positive value. Strictly speaking, this is not a case of censoring, because the observed sample is not limited by non-observability (e.g., due to rounding) of trade below this value.

in the selection equation, μ_{ij}, in order for the selection decision to be positive. Because of the positive correlation, $\rho_{\varepsilon\mu}$, the expected disturbance term in the regression model, ε_{ij}, will be positive as well. As a result, observed trade will be expected to be higher than potential trade, which is unconditional on being observed or not. The observed sample will be biased upward at low levels of institutional quality. OLS estimates of the regression coefficient for institutional quality, for the observed sample of positive trade, will be biased toward zero as a result. This is technically known as sample selection bias. Thus, the sample selection model allows us to tackle the exact problem noted earlier in this chapter: zero flows may lead to underestimation of the effect of search and insecurity costs variables on bilateral trade.

The model in equation (5.5) can be estimated using maximum likelihood (ML) estimation (see Appendix 5A). The results for organized-exchange products (excl. petroleum), reference-price products and differentiated products appear in Table 5.5. The first three columns display the results for the selection equations, the last three present the regression equations.

The results for the regression equations are very similar to the OLS estimates on the non-zero sample in Table 5.2. Most of the parameter estimates are slightly larger in size, indicating that the OLS estimates are somewhat biased toward zero. However, the effect is minimal. This is related to the fact that the correlation between the selection and regression equations, $\rho_{\varepsilon\mu}$, is fairly low for each product type (although always statistically significantly above zero). As a result, sample selection bias is relatively small.[14] This also implies that the conclusions reached for the non-zero sample still stand after accounting for the influence of zero flows.

[14] However, if we compute marginal effects of the regressors on the basis of the ML estimates and the correlation estimate, these slope parameters, conditional on trade being observed, still vary considerably from the (unconditional) ML estimates (see Appendix 5A). The fact that OLS bias is much smaller, although OLS results are based only on the sample conditional on trade being observed, reflects that the extent of bias from OLS in a(n) (incidentally) truncated sample is not generally determined, but depends on the distribution of the regressors in the observed sample, given the observed values for the dependent variable (Greene, 2000). Because we are interested in the effect of regressors on potential trade (whether observed or not), the ML estimates are relevant, and not the conditional marginal effects.

Table 5.5 Gravity equations: zero flows

	Selection equations:			Regression equations:		
	Org.Exch. (exc. petr.)	Reference priced	Differen-tiated	Org.Exch. (exc. petr.)	Reference priced	Differen-tiated
Log GDP exporter	0.60***	0.53***	0.52***	1.06***	1.06***	1.31***
	(49.73)	(42.74)	(37.88)	(47.33)	(61.49)	(91.06)
Log GDP importer	0.38***	0.36***	0.36***	1.01***	0.90***	0.83***
	(35.84)	(32.41)	(29.46)	(44.26)	(52.70)	(58.25)
Log Distance	–0.63***	–0.66***	–0.59***	–1.04***	–1.26***	–1.37***
	(29.53)	(26.54)	(20.79)	(26.88)	(43.17)	(53.00)
Log GDP/cap exporter	–0.20***	–0.03*	–0.04*	–0.14***	0.08*	–0.16***
	(9.81)	(1.75)	(1.65)	(2.60)	(1.80)	(4.60)
Log GDP/cap importer	–0.05**	–0.04**	–0.02	–0.05	–0.08**	–0.04
	(2.53)	(2.12)	(0.83)	(1.06)	(2.03)	(1.29)
Border Dummy	0.63***	0.64**	–0.06	1.26***	0.98***	0.87***
	(3.93)	(2.29)	(0.20)	(7.76)	(6.41)	(6.15)
Trade area Dummy	0.59***	0.56***	0.68***	0.78***	0.81***	0.54***
	(7.89)	(5.94)	(5.22)	(7.32)	(9.22)	(6.97)
Language Dummy	0.22***	0.45***	0.77***	0.35**	0.41***	0.62***
	(3.15)	(5.67)	(7.73)	(2.12)	(3.41)	(6.20)
Colonial Dummy	0.30***	0.29***	0.37***	0.75***	0.62***	0.52***
	(5.21)	(4.58)	(4.67)	(5.41)	(6.00)	(5.95)
Religion Dummy	0.07**	0.13***	0.23***	–0.14	–0.03	0.14***
	(1.97)	(3.23)	(4.71)	(1.60)	(0.44)	(2.74)
Instit. quality exporter	0.50***	0.54***	0.53***	0.16*	0.29***	0.86***
	(15.01)	(16.15)	(13.91)	(1.82)	(4.27)	(15.31)
Instit. quality importer	0.26***	0.31***	0.41***	–0.01	0.16***	0.41***
	(8.11)	(9.12)	(10.86)	(0.17)	(2.62)	(7.90)
Institutional distance	–0.05***	–0.03***	–0.04***	–0.10***	–0.12***	–0.08***
	(6.95)	(4.08)	(4.52)	(6.13)	(10.78)	(8.66)
Constant	–16.18***	–14.46***	–14.09***	–35.70***	–31.05***	–32.61***
	(41.97)	(36.45)	(31.39)	(44.85)	(53.04)	(69.28)
$\rho_{\varepsilon\mu}$				0.20	0.11	0.12
σ_{ε}				2.79	2.42	2.20
Inverse Mills ratio (λ) †				0.56	0.27	0.27
Observations	14042	14042	14042	14042	14042	14042
… of which zero trade:	7227	5034	2983	7227	5034	2983
log likelihood ‡				–21690.73	–25494.58	–28381.38
Wald-statistic				7900.41	16172.29	30558.82

Notes: Sample selection model, estimated using ML. Absolute value of robust z-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable regression equation: log bilateral exports. †: Inverse Mills ratio computed at the mean value of the regressor variables. ‡: Log likelihood applies to complete selection model, including both selection and regression equation.

The network/search costs view is supported empirically. The distance and language effects on trade are most important for differentiated products and least important for organized-exchange goods. The same holds for the effect of religion. Only the effect of colonial ties remains at odds with the hypothesis. The central hypothesis of this chapter, concerning the effect of property security, receives empirical support as well. Institutional quality is important for trade in both differentiated and homogeneous products. But the effect is by far highest on trade in differentiated goods. The effect of institutional distance, reflecting adjustment costs and the ability to operate in foreign institutional environments, is negative for all sectors. As before, there is no clear pattern of relative importance across sectors, though. The support for the complementary network and insecurity views, after accounting for zero flows, is somewhat stronger than in the balanced non-zero sample. Those results, in Table 5.3, were somewhat less conclusive, mainly with respect to the distance effect. The balanced sample is very similar to the non-zero sample for organized-exchange goods. As suggested earlier, this could imply that the results for the other product groups become more similar in the balanced sample, dampening the difference in effects.

The selection equations, in themselves, also provide interesting observations on trade costs that allow us to draw some additional inferences. First, the search and insecurity costs variables are important in determining profitability as well as the size of expected (potential) trade. Second, apart from language and importer institutional quality, most trade costs factors are roughly of equal importance across product groups.[15] This suggests that additional (fixed as well as variable) costs are important for establishing trade relations in all types of products. These costs relate to setting up transport links, establishing delivery contracts and to the security of supply chains. Note that these costs are separate from the variable trade costs, related to the search for a suitable product and its direct contracting costs. Even in homogeneous products, with moderate to little search costs, transport links and delivery contracts have to be established to have the product delivered from the supplier to the

[15] Note that this also holds for colonial links, which even seem somewhat more important for profitability in differentiated goods trade. The relatively bigger effect of colonial links in the regression equation for homogeneous goods, in contrast, could reflect comparative advantages and resource availability rather than trade costs differences. Furthermore, the selection equations may give a better indication of the effect of religious similarities on trade related costs in homogeneous goods than its direct effect on the size of trade. Finally, the strong negative effect of exporter GDP per capita on the profitability of exporting organized-exchange goods provides evidence for the role of comparative advantages on trade patterns in these goods.

customer. This involves additional search and transaction costs with additional economic agents in the supply chain, some of which are fixed costs that become sunk once they have been made. These costs increase delivery prices and have to be recovered over time. This explains why they affect both the profitability and size of bilateral trade flows. The decisions whether to trade and what amount to trade are thus related, because the setting in which both take place is the same (e.g., the level of institutional protection). However, at the micro-economic level, supply chain management involves different parties and is similar regardless of product type. This is also reflected in a rather low correlation between both decisions ($\rho_{\varepsilon\mu}$).

5.6 Summary and conclusions

Unobserved barriers to trade appear to be important for the explanation of international trade patterns. Recent research has suggested that networks and search costs are important for explaining the size of trade and the differences in trade patterns between homogeneous and differentiated goods. Other studies emphasize the difficulties of protecting property rights and securing contract enforceability, given the prominence of incomplete contracts, in transactions that extend across national jurisdictions. This chapter argues that both explanations can be combined, since the existence of poor contract enforcement aggravates the selectiveness of trade relations that are subject to high search and other transaction costs. We estimate a gravity model for trade in organized-exchange products, reference-priced and differentiated products that confirms the hypothesis. Institutions matter most for trade in differentiated products. Still, property security and contract enforcement are generally important for trade in homogeneous products as well. This suggests that even for trade that takes place at arm's length, transaction costs are relevant. If good governance is most important for exporting and importing differentiated goods, this may provide new insight in specialization patterns, economic development and intra-industry trade. In order to extend its competitiveness and export base into differentiated commodities, establishing a high-quality domestic institutional environment is an important pre-requisite.

The large number of zero-entried trade flows, especially in the organized-exchange group, may cause bias in the regression results. If zero-flow observations tend to occur between distant countries that do not exhibit cultural or historical links, the omission of these observations tends to reduce the effects related to search and other transaction costs. A sample selection model has been estimated for each product group to properly deal with zero flows. The results again confirm that institutional quality affects trade in differentiated products most. Moreover, it shows that institutions and search costs variables matter for the decision whether to trade at all, as well as for the potential size of bilateral exports. Differences across product types are less pronounced in this selection stage, indicating that fixed costs in establishing transport links are important for both homogeneous and differentiated products.

Apart from the extra information provided by the selection model, the results for the level regressions suggest that OLS on a non-zero sample may not lead to much bias in practice. The results have shown only limited residual correlation between the decision whether to trade at all and the decision how much to trade. Hence, OLS does not suffer greatly from selection bias. As shown in Appendix 5B, several alternative approaches to deal with zero flows yield larger differences in estimates, compared to OLS. These results may be misleading, however, as they rely on ad-hoc assumptions, or artificial truncation. Hence, we draw the conclusion that omitting zero flows from the regression sample leads to satisfactory results in our case, even at disaggregated levels of trade, and is preferred to the use of a Tobit model or ad-hoc substitutions for zero flows. On theoretical grounds, estimation of a sample selection model is preferred, because of the extra information on trade patterns provided by the selection mechanism.

Appendix 5A Estimation of the sample selection model

In this appendix, we present the likelihood function of the sample selection model estimated in section 5.4. We will illustrate sample selection bias when the correlation between the selection and regression model is positive. Estimates of the marginal effects, conditional on non-zero trade being observed, show the consequences of selection bias and conclude the appendix.

Let us repeat the sample selection model, defined in equation (5.5):

$$\begin{aligned}
&\ln(T_{ij}) = \ln(\tilde{T}_{ij}); s_{ij} = 1 \quad \text{if } \tilde{\pi}_{ij} > 0\\
&\ln(T_{ij}) = \text{not observed}; s_{ij} = 0 \quad \text{if } \tilde{\pi}_{ij} \leq 0\\
&\text{where:}\\
&\ln(\tilde{T}_{ij}) \quad = x'_{1i}\beta_1 + x'_{2j}\beta_2 + x'_{3ij}\beta_3 + \varepsilon_{ij}\\
&\tilde{\pi}_{ij} \qquad = x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 + \mu_{ij}\\
&x_1, x_2 \text{ and } x_3 \text{ are vectors of exporter- and importer specific and bilateral regressors}\\
&\beta_k \text{ and } \gamma_k, k \in \{1,2,3\} \text{ are vectors of regression and selection parameters, and:}\\
&(\varepsilon, \mu) \sim \text{bivariate normal}\left(0, 0, \sigma_\varepsilon, \sigma_\mu, \rho_{\varepsilon\mu}\right)
\end{aligned} \quad . \quad (5.6)$$

The parameters in equation (5.6) can be estimated using maximum likelihood. We follow Verbeek (2000, section 7.4.2) to derive the likelihood functions for an individual observation. Although both decisions in the model are most naturally thought of as occurring simultaneously, it is instructive to view the two parts separately when constructing the likelihood function. The selection equation essentially describes a binary choice problem. Therefore, the contribution to the likelihood is the probability of observing $s_{ij} = 1$ ($\tilde{\pi}_{ij} > 0$), if trade is non-zero, and $s_{ij} = 0$ ($\tilde{\pi}_{ij} \leq 0$), if trade is zero. The contribution for non-zero trade furthermore consists of the conditional probability density of observed trade given that trade is actually taking place, $f(\ln(T_{ij}) \mid s_{ij} = 1)$. This results in the following log likelihood function:

$$\ln L(\beta, \gamma, \sigma_\varepsilon, \rho_{\varepsilon\mu}) = \sum_{T_{ij}=0} \ln P\{s_{ij} = 0\} + \sum_{T_{ij}>0} \left[\ln f\left(\ln(T_{ij}) \mid s_{ij} = 1\right) + \ln P\{s_{ij} = 1\}\right]. \quad (5.7)$$

The conditional distribution of $\ln(T_{ij})$, given that $s_{ij} = 1$, is rather complicated. However, a reformulation simplifies matters substantially (Verbeek, 2000; Bikker and De Vos, 1992). We can use a general rule for joint distributions, that is:

$$f\left(\ln(T_{ij}) \mid s_{ij} = 1\right) P\{s_{ij} = 1\} = P\{s_{ij} = 1 \mid \ln(T_{ij})\} f\left(\ln(T_{ij})\right). \tag{5.8}$$

The probability density of log trade follows a normal distribution, whereas the probability in the first term on the right-hand side is from a conditional normal density function. Using the underlying latent selection variable, this conditional normal density function has the following mean and variance.

$$\begin{aligned}
E\{\tilde{\pi}_{ij} \mid \ln(T_{ij})\} &= x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 + E\{\mu_{ij} \mid \varepsilon_{ij}\} \\
&= x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 + \frac{\sigma_{\varepsilon\mu}}{\sigma_\varepsilon^2}\left(\ln(T_{ij}) - x'_{1i}\beta_1 - x'_{2j}\beta_2 - x'_{3ij}\beta_3\right) \\
V\{\tilde{\pi}_{ij} \mid \ln(T_{ij})\} &= 1 - \frac{\sigma_{\varepsilon\mu}^2}{\sigma_\varepsilon^2} = 1 - \rho_{\varepsilon\mu}^2
\end{aligned} \quad . \tag{5.9}$$

Thus:

$$\tilde{\pi}_{ij} \mid \ln(T_{ij}) = x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 + \frac{\sigma_{\varepsilon\mu}}{\sigma_\varepsilon^2}\left(\ln(T_{ij}) - x'_{1i}\beta_1 - x'_{2j}\beta_2 - x'_{3ij}\beta_3\right) + \eta_{ij}$$

$$\eta_{ij} \sim \text{independent } N\left(0, (1 - \rho_{\varepsilon\mu}^2)\right)$$

With the modification in equation (5.8) and the conditional distribution in equation (5.9), the log likelihood can be written as follows.

$$\ln L(\beta, \gamma, \sigma_\varepsilon, \rho_{\varepsilon\mu}) = \sum_{T_{ij}=0} \ln P\{s_{ij} = 0\} + \sum_{T_{ij}>0} \left[\ln f\left(\ln(T_{ij})\right) + \ln P\{s_{ij} = 1 \mid \ln(T_{ij})\}\right]. \tag{5.10}$$

The relevant probabilities and probability density for an individual observation, with either observed trade or zero trade, directly result from equations (5.6) and (5.9):

$$
\begin{aligned}
P\{s_{ij}=0\} \quad & = P\{\tilde{\pi}_{ij} \leq 0\} = P\{\mu_{ij} \leq -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3\} \\
& = 1 - \Phi\left(x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3\right) \\
P\{s_{ij}=1 \mid \ln(T_{ij})\} \quad & = P\{\tilde{\pi}_{ij} > 0 \mid \ln(T_{ij})\} = P\{\eta_{ij} > -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3 \\
& \quad -\frac{\sigma_{\varepsilon\mu}}{\sigma_\varepsilon^2}\left(\ln(T_{ij}) - x'_{1i}\beta_1 - x'_{2j}\beta_2 - x'_{3ij}\beta_3\right)\} = \\
& = \Phi\left(\frac{x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 + \left(\sigma_{\varepsilon\mu}/\sigma_\varepsilon^2\right)\left(\ln(T_{ij}) - x'_{1i}\beta_1 - x'_{2j}\beta_2 - x'_{3ij}\beta_3\right)}{\sqrt{1-\rho_{\varepsilon\mu}^2}}\right) \\
f\left(\ln(T_{ij})\right) \quad & = \frac{1}{\sigma_\varepsilon}\phi\left(\frac{\ln(T_{ij}) - x'_{1i}\beta_1 - x'_{2j}\beta_2 - x'_{3ij}\beta_3}{\sigma_\varepsilon}\right)
\end{aligned}
\quad , \quad (5.11)
$$

where $\phi(.)$ and $\Phi(.)$ stand for the standard normal probability density and cumulative distribution function, respectively.

The log likelihood function in equation (5.10), maximized with respect to the unknown parameters from the sample selection model, leads to consistent and asymptotically efficient estimators for the parameters of the selection and regression equations (Verbeek, 2000, p. 211).

The most important property of the sample selection model is its flexibility with respect to the influence of zero-trade observations. The model includes separate explanatory equations for selection and potential size of the action of primary interest, but allows correlation between both stages. If the residuals in both stages are correlated, the non-random sampling implied by the selection equation leads to sample selection bias in the observed (non-zero trade) sample. We can illustrate this by confining ourselves to the model in equation (5.6), as it applies to the non-zero trade observations in our sample. In particular, consider the conditional expectation of log trade, given that trade is profitable to begin with (for further details, see Greene, 2000; Verbeek, 2000):

$$
\begin{aligned}
E\{\ln(T_{ij}) \mid \ln(T_{ij})\text{is observed}\} &= E\{\ln(T_{ij}) \mid \tilde{\pi}_{ij} > 0\} \\
&= E\{\ln(T_{ij}) \mid \mu_{ij} > -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3\} \\
&= x'_{1i}\beta_1 + x'_{2j}\beta_2 + x'_{3ij}\beta_3 + E\{\varepsilon_{ij} \mid \mu_{ij} > -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3\} \\
&= x'_{1i}\beta_1 + x'_{2j}\beta_2 + x'_{3ij}\beta_3 + \frac{\sigma_{\varepsilon\mu}}{\sigma_\mu^2} E\{\mu_{ij} \mid \mu_{ij} > -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3\} \\
&= x'_{1i}\beta_1 + x'_{2j}\beta_2 + x'_{3ij}\beta_3 + \frac{\sigma_{\varepsilon\mu}}{\sigma_\mu} \frac{\phi\left(x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 / \sigma_\mu\right)}{\Phi\left(x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3 / \sigma_\mu\right)} \quad . \qquad (5.12) \\
&= x'_{1i}\beta_1 + x'_{2j}\beta_2 + x'_{3ij}\beta_3 + \rho_{\varepsilon\mu}\sigma_\varepsilon\lambda\left(\alpha_{ij}\right)
\end{aligned}
$$

with $\sigma_\mu \equiv 1; \alpha_{ij} = -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3$

and $\lambda\left(\alpha_{ij}\right) = \dfrac{\phi\left(x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3\right)}{\Phi\left(x'_{1i}\gamma_1 + x'_{2j}\gamma_2 + x'_{3ij}\gamma_3\right)}$

The expectation of the conditional disturbance term in the selection equation (μ_{ij}) exceeds zero, given that it is truncated from below in the observed-trade sample. To judge whether this leads to sample selection bias in the regression equation, we have to consider the expectation of the regression disturbance term (ε_{ij}), conditional on the truncation in the selection equation. From equation (5.12), the expectation of ε_{ij}, given that μ_{ij} is truncated from below, exceeds zero if $\rho_{\varepsilon\mu}$ is positive. The estimates in the main text of this chapter, Table 5.5, indeed show a positive correlation between ε_{ij} and μ_{ij}. Thus, the conditional expected value of (log) trade, given that trade is observed, exceeds expected potential trade, unconditional on being observed or not. In other words, OLS regression of log trade on the regressor variables, using only non-zero trade observations, produces inconsistent estimates of the regression parameters in $\beta_k, k \in \{1,2,3\}$. This bias is known as sample selection bias. It can be seen most intuitively by summarizing the complete model as it applies to the non-zero sub sample.

$$
\begin{aligned}
\ln\left(T_{ij}\right) \mid \left(s_{ij} = 1\right) &= E\{\ln\left(T_{ij}\right) \mid \left(s_{ij} = 1\right)\} + \nu_{ij} \\
&= x'_{1i}\beta_1 + x'_{2j}\beta_2 + x'_{3ij}\beta_3 + \beta_\lambda\lambda\left(\alpha_{ij}\right) + \nu_{ij}, \qquad (5.13)
\end{aligned}
$$

where $\beta_\lambda = \rho_{\varepsilon\mu}\sigma_\varepsilon$

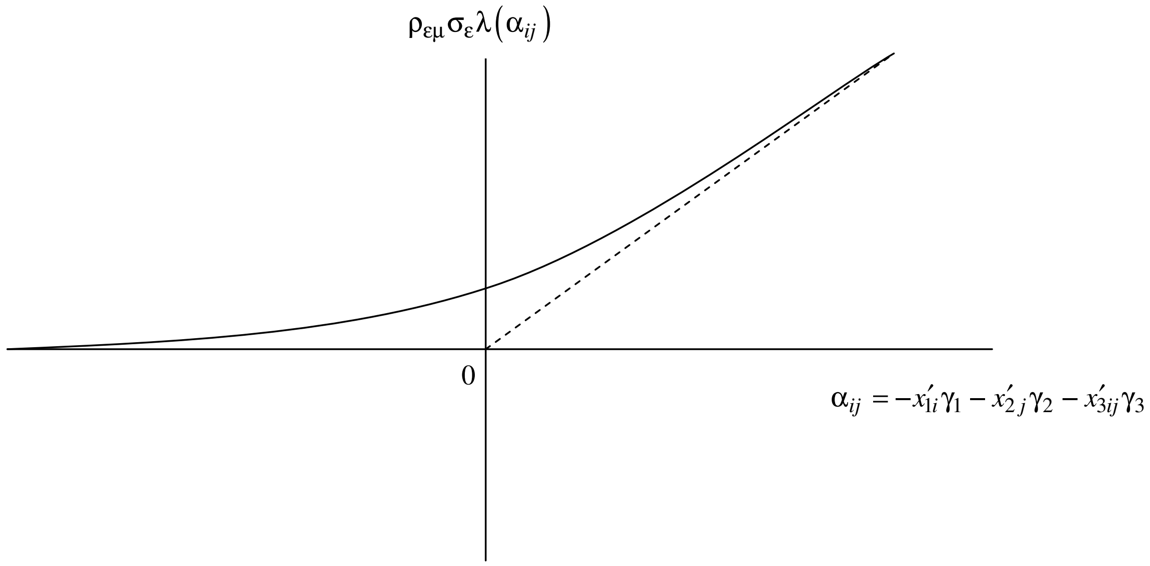
If $\beta_\lambda \neq 0$, an OLS regression omitting λ from the model suffers from omitted variable bias. On the other hand, if we can include λ in the specification, OLS will produce consistent estimates of $\beta_k \left(k \in \{1,2,3\}\right)$, although inefficient because ν_{ij} is heteroskedastic (see Greene, 2000, section 20.4.1 for more details). This concept is the basis for an alternative method often used in empirical applications to estimate the selection model, without the need to estimate the full model by maximum likelihood. The two-step estimation procedure, due to Heckman (1979) and also known as the 'Heckit' estimator, estimates equation (5.13) by OLS. However, λ_{ij} is not directly observed. Therefore, the first step is to estimate the selection equation as a binary Probit model, using maximum likelihood. The estimates for $\gamma_k \left(k \in \{1,2,3\}\right)$ can then be used to compute $\hat{\lambda}_{ij}$, as estimates of λ_{ij}, and substitute these in the second-step OLS regression. This method is often simpler to apply than full maximum likelihood. However, it has some drawbacks. Apart from heteroskedasticity, the fact that $\hat{\lambda}_{ij}$ is estimated leads to less efficiency, and inconsistency of OLS standard errors. Most importantly, the method may not give reliable results if the share of zero flows is very large (Hillberry, 2002). Because the explanatory variables in the selection and regression equations are identical, the second-step OLS regression is only identified because $\hat{\lambda}_{ij}$ is nonlinear (see Verbeek, 2000). A large share of 'limit' observations (i.e., zero flows) may imply little variation in $\hat{\lambda}_{ij}$ across the sample, such that $\hat{\lambda}_{ij}$ is close to a linear function of the regressor variables. Because of these problems with the Heckit procedure, we have relied on full maximum likelihood estimation in this chapter, also because it turned out to work well in practice.[16]

As shown by equations (5.12) and (5.13), the conditional expectation of log trade is different from the unconditional expectation of potential trade, because of the term $\lambda\left(\alpha_{ij}\right) = \lambda\left(-x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3\right) > 0$. For positive $\rho_{\varepsilon\mu}$, the conditional expected value

[16] Results based on the Heckit two-step procedure are not reported, but are available upon request. The regression parameters did not differ much qualitatively. There are some quantitative differences in parameter estimates, though. Most importantly, the estimates for ρ are much larger.

exceeds unconditional expected potential trade. Figure 5.1 below illustrates how the size of this difference depends on the expected value of the latent selection variable (profitability).[17]

Figure 5.1 $\mathrm{E}\left[\ln\left(\mathrm{T_{ij}}\right) \mid \ln(\mathrm{T_{ij}}) \text{ is observed}\right] - \mathrm{E}\left[\ln\left(\tilde{\mathrm{T}}_{\mathrm{ij}}\right)\right]$ *as a function of* $-E\left[\tilde{\pi}_{ij}\right]$.



The figure shows that conditional expected trade is highest, compared to unconditional expected trade, for low values of expected profitability. Given the positive correlation $\rho_{\varepsilon\mu}$, this makes sense. In order to assure profitability, the realization for the disturbance term μ_{ij} should be high. Given the truncation in the selection equation, the expected value of trade will be high as well.

Apart from the relationship between expected profitability and conditional expected trade, it is important to establish the potential consequences of truncation in the selection equation for sample selection bias of OLS. We may conclude from our estimation results in Table 5.5 that the difference between conditional and unconditional expected trade is highest for low values of unconditional expected trade, because the explanatory variables in our model have the same sign in both the selection and the regression equation. This corresponds to the intuitive argument in the main text. A low expected profitability goes together with low

[17] The figure is based on Figure 20.2 in Greene (2000).

expected trade. Therefore, trade flows that we observe between countries that have, for example, low institutional quality levels, or are distant from each other, will be most above their unconditional expected value, on average. The regression plane tends to be flattened by the sample selection process. As a result, the effect of these explanatory variables on expected trade in the 'observed' sample of non-zero bilateral trade will underestimate the true effect on unconditional expected potential trade.

The sample selection effect in the non-zero sample can be illustrated by considering the marginal effects of the regressors, conditional on trade being observed in the first place. These slope parameters are different from the marginal effects on unconditional expected trade, which are given by the estimates of $\beta_k \left(k \in \{1,2,3\}\right)$. The marginal effect of regressor $x_{lm}\,(l \in \{1,2,3\}; m \in \{1,...,M_l\})$ in the observed-trade sample can be computed from the maximum likelihood estimates of β and γ and is given below. Differentiate equation (5.12) with respect to the regressor, using the chain rule, to find:

$$\frac{\partial E[\ln(T_{ij}) \mid s_{ij} = 1, x_{lm}]}{\partial x_{lm}} = \beta_{lm} - \gamma_{lm}\left(\rho_{\varepsilon\mu}\sigma_{\varepsilon}\right)\delta(\alpha_{ij}), \tag{5.14}$$

where:

$\delta(\alpha_{ij}) = \lambda^2(\alpha_{ij}) - \alpha_{ij}\lambda(\alpha_{ij}) = \partial\lambda_{ij}/\partial\alpha$; $\alpha_{ij} = -x'_{1i}\gamma_1 - x'_{2j}\gamma_2 - x'_{3ij}\gamma_3$ and $\lambda(\alpha_{ij}) = \phi\left(-\alpha_{ij}\right)/\Phi\left(-\alpha_{ij}\right)$, and using that $d\phi(-\alpha_{ij})/d\alpha = -\alpha_{ij}\phi(-\alpha_{ij})$ (see Greene, 2000).

Table 5A.1 presents the estimates for the marginal effects on trade in the non-zero sub sample, computed at the mean values for the regressors.[18]

[18] For dummy regressors, the discrete effect on conditional expected (log) trade of an increase from zero to one has been calculated.

Table 5A.1 Sample-selection gravity model: marginal effects in the non-zero sample

	(1) Org.Exchange (excl. petroleum)	(2) Reference priced	(3) Differentiated
Log GDP exporter	0.85	1.00	1.28
	(32.31)	(54.60)	(88.29)
Log GDP importer	0.88	0.86	0.82
	(35.33)	(47.89)	(56.57)
Log Distance	-0.82	-1.19	-1.34
	(19.82)	(38.61)	(51.88)
Log GDP/cap exp.	-0.07	0.08	-0.16
	(1.32)	(1.88)	(4.55)
Log GDP/cap imp.	-0.04	-0.07	-0.04
	(0.71)	(1.90)	(1.26)
Border Dummy	1.07	0.93	0.87
	(6.51)	(6.08)	(6.21)
Trade area Dummy	0.59	0.76	0.52
	(5.38)	(8.61)	(6.68)
Language Dummy	0.27	0.37	0.60
	(1.68)	(3.06)	(5.97)
Colonial Dummy	0.65	0.59	0.50
	(4.71)	(5.70)	(5.78)
Religion Dummy	-0.16	-0.04	0.13
	(1.91)	(0.66)	(2.55)
Instit. quality exporter	-0.02	0.23	0.83
	(0.17)	(3.37)	(14.86)
Instit. quality importer	-0.11	0.12	0.39
	(1.31)	(2.04)	(7.53)
Institutional distance	-0.08	-0.12	-0.08
	(5.09)	(10.43)	(8.44)
Conditional average log trade	3.97	5.05	5.59

Note: t-statistics in parentheses.

Comparing the results to Table 5.5 in the main text, the conditional marginal effects indeed show evidence of a sample selection effect. The bias is small for reference-priced and differentiated goods. For organized-exchange products, the bias is more pronounced, because of the higher correlation between the selection and regression equations for that product group. Moreover, the relatively large bias also reflects that mean trade is lower for trade in organized-exchange goods. Thus, the conditional marginal effect is more heavily influenced by the probability of non-selection and the truncation in the selection equation.

It is surprising that sample selection bias is less evident in the OLS results for the non-zero sample, as remarked earlier in the main text. We must keep in mind, however, that the marginal effects computed in this appendix are based on the consistent ML estimates, which incorporate the information provided by non-zero flows and zero flows alike. The OLS estimates only consider the non-zero sample. In this context, Greene (2000) notes that the extent of bias in OLS estimates depends on the distribution of the regressors in this sub sample. So, it is not possible to determine beforehand whether the bias of OLS is likely to be serious. Therefore, even though the OLS results prove to be fairly close to the results in the sample selection model in our case, it is preferable to use the sample selection model.[19]

Appendix 5B Extensions: Tobit and other approaches to deal with zero flows

Apart from the selection model, the gravity literature has used various methods to deal with the presence of zero flows in the sample. As discussed in the main text, the most common approaches are: Tobit regression, truncated regression, substituting small positive numbers for zero flows, or simply omitting the zero entries from the analysis. The latter approach was followed in section 5.4 and has proven surprisingly robust, compared to the outcomes of the more sophisticated econometric approach put forward in section 5.5. This still leaves us with the three other approaches listed above, which explicitly take zero flows into account. We will briefly discuss the application of these methods. Table 5.B.1 illustrates the results using these methods in the setting of this chapter. We confine the presentation of results to the organized-exchange product group, in which zero flows are most prominent. Consequently, the sensitivity and robustness of results is most clearly illustrated by this sector.

Several studies have used the standard Tobit model, as described in equation (5.4) to estimate the gravity equation with zero flows (e.g., Rose, 2004; Soloaga and Winters, 2001; Anderson and Marcouiller, 2002). Because censoring at zero is not possible in the log-linear gravity equation, the censoring limit has to occur at positive trade. Some studies refer to rounding of trade flows, such that the censoring limit is located at (50% of) the recording limit of trade. Usually, they subsitute a value smaller than or equal to the threshold for the

[19] Note that we are interested primarily in the unconditional marginal effects in the regression equation (the ML estimates of β_k), because they describe the patterns of expected potential trade, whether observed or not. The conditional marginal effects are presented mainly to illustrate the potential selection bias in OLS regression.

zero-flow observations, and estimate the Tobit model in its log-linear variant, equation (5.4). Zuehlke (2003) shows that the minimum order statistic from the (non-zero) sample will be the ML estimator of the censoring threshold, if it is a-priori unknown at what value censoring takes place. In other words, this motivates to choose the censoring limit at the lowest observed trade value in the observed (ie., non-zero) sample. For our sample, the lowest observed trade value is US$ 1 (0.001 in the WITS COMTRADE database). Strictly speaking, this also involves rounding: trade values are rounded to the nearest dollar.

The first specification in Table 5B.1 presents the Tobit estimates with censoring at $\ln(0.001)$. The Tobit model is estimated using maximum likelihood procedures, in which the zero flows are assumed to arise because trade falls short of the censoring limit. Clearly, the Tobit results in specification (1) are unsatisfactory. Although the sign of most parameters is comparable to the regression results presented in the main text, the absolute size of the parameter estimates has inflated beyond credible limits. This gives a clear indication that the vast majority of zero flows cannot be explained by the fact that their potential values fall short of the observation limit of US$ 1.

Statistical theory and intuition suggest that an unknown censoring limit will equal the lowest observed value in the observed sample, which provided the rationale for the model in specification (1). However, the crucial assumption behind this suggestion is that censoring due to unobservability (in particular, rounding to zero) is in fact the (most important) explanation for the zero-valued (or missing) observations on bilateral trade. Evidently, zero flows are the result of economic decision making, rather than rounding issues, which only play a minor role.[20] The models in specifications (2) and (3), therefore, depart from the idea of censoring due to rounding thresholds. Instead, we introduce artificial censoring of trade at

[20] Bikker and De Vos (1992) have illustrated that the Tobit model is suitable “for rounded figures, when rounding is the only cause of zero flows” (p. 395). They show, in contrast, that the influence of rounding to zero as a cause for the zero flows that occur in actual trade data, is limited. They used data for 1959 and 1976, in which rounding thresholds appear to be more substantial than in our database, suggesting that the issue is of even less significance in our data.

US$ 1000 and at the mean expected value of zero flows, respectively. All trade below these values (including the zero-entried observations) is assumed to be censored.

Table 5B.1 Zero flows: alternative estimations for organized-exchange goods

	(1)	(2)	(3) †	(4)	(5)	(6) †
	Tobit: censoring at $1	Tobit: censoring at $1000	Tobit: censoring at mean exp. value zero flows	Truncated regression at mean exp. value zero flows	OLS: $1 for zeros	OLS: zeros set at mean exp. value
Log GDP exporter	3.31***	1.92***	1.60***	0.86***	1.86***	0.74***
	(65.30)	(67.47)	(65.19)	(38.49)	(83.07)	(59.03)
Log GDP importer	2.30***	1.46***	1.28***	0.88***	1.32***	0.63***
	(47.22)	(53.15)	(54.01)	(38.29)	(52.60)	(45.95)
Log Distance	–3.36***	–1.92***	–1.58***	–0.81***	–1.84***	–0.69***
	(37.08)	(38.27)	(37.30)	(21.67)	(37.26)	(25.68)
Log GDP/cap exp.	–0.87***	–0.45***	–0.38***	–0.12**	–0.48***	–0.15***
	(8.33)	(7.66)	(7.51)	(2.28)	(8.86)	(5.54)
Log GDP/cap imp.	–0.29***	–0.17***	–0.13**	0.01	–0.17***	–0.07**
	(2.83)	(2.82)	(2.56)	(0.23)	(3.26)	(2.56)
Border Dummy	2.43***	1.72***	1.52***	1.07***	2.35***	1.47***
	(5.28)	(6.85)	(7.33)	(7.22)	(8.32)	(9.41)
Trade area Dummy	0.88***	0.89***	0.84***	0.82***	1.47***	1.22***
	(3.14)	(5.80)	(6.55)	(8.63)	(9.71)	(12.72)
Language Dummy	1.31***	0.78***	0.68***	0.32**	0.94***	0.38***
	(3.77)	(4.01)	(4.16)	(2.07)	(4.88)	(3.70)
Colonial Dummy	2.35***	1.31***	1.01***	0.66***	0.97***	0.25***
	(7.95)	(7.99)	(7.26)	(4.89)	(5.79)	(2.89)
Religion Dummy	0.55***	0.12	0.02	–0.14*	0.02	–0.21***
	(2.88)	(1.15)	(0.20)	(1.66)	(0.19)	(3.87)
Instit. quality exporter	1.75***	0.87***	0.65***	–0.00	1.21***	0.39***
	(10.59)	(9.41)	(8.22)	(0.01)	(13.43)	(8.68)
Instit. quality importer	0.87***	0.42***	0.30***	–0.08	0.66***	0.25***
	(5.23)	(4.48)	(3.84)	(1.07)	(7.69)	(5.76)
Institutional distance	–0.03	–0.08***	–0.08***	–0.07***	–0.11***	–0.12***
	(0.97)	(4.09)	(5.39)	(4.42)	(5.90)	(11.68)
Constant	–102.35***	–60.01***	–50.12***	–29.24***	–56.37***	–21.17***
	(60.86)	(63.04)	(60.89)	(35.62)	(67.34)	(45.53)
Observations	14042	14042	14042	5780	14042	14042
of which 'censored'	7229	7662	8262			
Pseudo R-squared	0.17	0.22	0.24			
LR (chi^2)- / F-statistic	11123.95	11922.73	11602.41		2694.67	1283.15
Adjusted R-squared					0.60	0.50
log likelihood				–12096.18		
Wald-statistic				4744.43		

Notes: Absolute value of t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log bilateral exports (in US$ '000); †: the mean expected value of zero flows (US$ 8,180; i.e., denominated as 8.18) is based on an OLS regression on the observed (non-zero) sample [see Table 5.2, specification (3)].

The choice of the censoring limit in specification (2) is completely arbitrary, with the only convenience of censoring at zero ($\ln(1)=0$), as in the standard Tobit model. In specification (3), the threshold reflects the mean expected value of the zero flows in our data set, as derived from the OLS regression on the non-zero sample. This choice should ensure that most of the actual zero flows could be expected to fall short of the threshold value. Almost by construction, this should reduce the size of the regression parameters. The likelihood maximization does not yield parameters such that the expected value of zero flows is close to an unrealistically low value, as in the first Tobit model. A possible advantage of the artificial censoring of low trade values is that it takes out small trade flows that are prone to measurement errors and may be too influential in the regression model otherwise (Frankel, 1997; Rose, 2000). The variability in these flows may be less informative about the determinants of trade patterns, compared to larger flows. Thus, censoring them could improve the model's precision.

The results of both alternative Tobit models are more sensible than those in specification (1). Nevertheless, the parameter estimates are still quite high, in comparison with the relevant sample-selection model in Table 5.5 and the OLS estimates in specification (3) of Table 5.2. Since these Tobit model specifications are artificial and should keep parameter estimates more within reasonable bounds, their actual performance is not convincing. The potential advantage of dealing with measurement errors is insufficient to justify using them in our setting.

The model in specification (4) of Table 5B.1 presents an alternative that uses only the information provided by the non-zero observations. Truncated regression acknowledges that the distribution of trade flows is truncated around a threshold value. Accordingly, the regression parameters are estimated with ML, such that the probability densities across all non-limit observations, conditional on trade being above the threshold value, are maximized. The limit observations themselves are not included in this likelihood. Hillberry (2002) constitutes an example of a study on bilateral trade using truncated regression to estimate gravity equations. If censoring is the major cause of missing or zero-valued observations, truncated regression and Tobit estimation, based on the same truncation or censoring threshold, will yield consistent estimates. Tobit will be more efficient, however, as it uses more information (in particular, the information provided by the regressor variables and the censored nature of the zero flows). In our context, however, censoring is not relevant. As a result, we may expect that truncated regression gives better results, because it only uses observed flows. In fact, the estimation results are not at all similar with the censored regression model in specification (3), and much more comparable with the OLS and sample selection results in Table 5.2 and Table 5.5. So, truncated regression performs better in our context. However, the estimated parameters are rather low, which reflects the artificial truncating of observed trade flows. This leads to a flattening of the regression plane, as described earlier in the context of zero flows. As this flattening is only related to the size of trade, OLS on this truncated regression plane would probably lead to underestimation of the parameters. Truncated regression partly corrects for this, by considering conditional probability densities, but apparently does not completely compensate the bias.

Finally, models (5) and (6) reflect OLS regressions, in which zero flows have been replaced by a fixed value. Examples in the literature that followed this approach are Linnemann (1966), Van Bergeijk and Oldersma (1990), Wang and Winters (1991) and Raballand (2003). The model in specification (5) substitutes $1 (i.e., 0.001 instead of 0) for all zero flows. Because it closely resembles zero, but can still be handled by the log-linear gravity model, this seems to be a 'good' choice for an arbitrarily small number. The last model replaces all zeros by their mean expected value from OLS without zero flows. The results are not robust to the size of the substituting value. If we decide to substitute $1, we will end up with the same problem as in specification (1). The method of OLS estimation tries to minimize the deviation of observed flows from their expected value. If $\ln(0.001)$ is not a good approximation of the expected value of zero flows, this will bias the absolute size of regression coefficients upward. Comparison between specifications (1) and (5) reveals that the bias is less severe for OLS than for Tobit with the threshold at $1. Tobit tends to depress the expected value of zero flows even further, below $\ln(0.001)$.

The value chosen in specification (6) is a better approximation of true expected potential trade for the zero flows in our sample. The results are mostly biased toward zero, however. Because the inserted value is the same for all zeros, it can still only reflect some zero flows adequately. In particular, if the zero flows are relatively diverse, in terms of their regressor variables and expected potential trade, representing them by a single average value tends to flatten the regression plane. This leads to downward bias in most of the parameter estimates.[21] In fact, the two final models in Table 5B.1 illustrate that inserting arbitrary values for zero flows is not a reliable solution. If the arbitrary value does not reflect the zero flows very well in terms of expected value, this method will cause bias in the parameter estimates. If, on the other hand, the value is chosen to reflect some 'second best' estimate of the average expected value of zero flows (e.g., based on OLS estimation in a sample with non-zero flows only)[22], the regression estimates will be biased as well.

All in all, this appendix shows the sensitivity of the results with respect to the method chosen to deal with zero flows. Trade in organized-exchange goods provides a clear illustration, because of the large share of zero flows in the sample (51.5%). Because the regression outcomes differ quite a lot, it is important to make a well-motivated decision on

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[21] Some of the parameters, in contrast, are larger in terms of size (e.g., for the border, RIA and institutions variables), compared to the results from the selection model and non-zero OLS. Generally, in multiple regression models, some of the parameters can be biased upward if the plane of observations is arbitrarily flattened, because some of the regressor variables may on average move in opposite directions for the observations concerned. The central point is to be made is, that inserting a fixed value for a set of heterogeneous observations will bias the estimator for the regression coefficients. Note that the flattening of the regression plane, compared to the non-zero sample, is clearly shown by the three most important regressors (the GDPs and distance) and the constant term.

[22] Earlier studies, in which fairly high rounding thresholds existed, have reflected the average value of zero flows by a specified fraction of the censoring threshold (e.g., Linnemann, 1966; Wang and Winters, 1991). Linnemann concluded that the OLS results based on non-zero flows only, overestimated the expected value of most zero flows, because most of them did not come close (in expectation) to the censoring limit (see Bikker, 1982). Therefore, he experiments with pre-specified fractions of the censoring limit to represent the expected value for those zero flows. In our context, as stated earlier, rounding thresholds are as good as absent (at US$ 1) and do not provide a good guideline for expected potential trade for zero flows. Therefore, we relied on the OLS results for non-zero flows to determine the average expected potential trade for zero flows.

how to deal with zero flows. We have seen that, in our context, censored or truncated regression and replacement of zero flows with arbitrary numbers are not preferable. Sample selection models, on the other hand, allow zero flows to be explained separately, as the outcome of, in principle, independent economic decisions of traders. This method correctly takes into account the information provided by zero-valued observations. Moreover, it encompasses censored regression as well as independent probit and (truncated) regression as special cases. Starting from an explicit theoretical framework on the causes of zero flows, sample selection allows for all kinds of data structures to emerge in practice. Therefore, this chapter has used a sample selection model to deal with zero flows in bilateral trade.

Chapter 6

Cultural Determinants of Bilateral Trade[1]

6.1 Introduction

In the previous chapters, we have seen that intangible barriers to trade that raise economic distance between countries are important to explain the patterns of trade. Cultural unfamiliarity, related to incomplete information, language differences, geographic distance and lack of historical ties, has often been studied in the literature on bilateral trade patterns as a dimension of economic distance. However, as we argued in Chapter 2, when cultures are familiar, this does not imply that they are similar to each other. Distance in terms of underlying values increases adjustment costs and lowers bilateral trust. This chapter investigates the effect of economic distance on trade, using the concepts of cultural unfamiliarity and cultural distance, controlling for institutional barriers to trade (see Chapter 4). In doing so, this chapter complements previous literature in two ways. First, we make an explicit conceptual and empirical distinction between cultural and institutional barriers to trade and examine their effects on bilateral trade flows simultaneously. Second, while previous research has typically used measures of cultural (un)familiarity, we include a measure of cultural (dis)similarity, based on the cultural framework of Hofstede (2001).

[1] This chapter is based on Linders et al. (2005c).

Cultural distance reflects the extent of differences in norms and values between countries, and allows us to go beyond cultural familiarity.

The remainder of this chapter is structured as follows. Section 6.2 discusses the effects of cultural familiarity and cultural distance on bilateral trade. Section 6.3 summarizes the research methodology, while section 6.4 reports our empirical findings. In section 6.5, we discuss these findings. Section 6.6 presents some extensions to the empirical specification to check the robustness of the results. Section 6.7 contains the concluding remarks.

6.2 Culture and bilateral trade

Many studies have found that bilateral trade increases when countries share a common language or colonial past (see Oguledo and MacPhee, 1994 and Frankel, 1997, for an overview). Although this indicates that these variables matter, they only capture cultural familiarity, in the sense that the trading partners will have more knowledge of each other's culture and markets and will find it easier to communicate and share information. As shown by Rauch (1999; 2001), trade networks that serve to lower information costs have historically developed along these lines of cultural familiarity (see Chapter 5). However, the fact that trading partners are familiar with each other's culture does not mean that their cultures are similar. While cultural familiarity only requires acquaintance between cultures and perhaps some form of endorsement, cultural similarity goes beyond acquaintance and acceptance, and requires shared norms and values between societies.

Several studies have used linguistic or religious (dis)similarity between countries to proxy cultural (dis)similarity (Srivastava and Green, 1986; Boisso and Ferrantino, 1997; Guiso et al., 2004). In these studies, language and religion serve to identify cultural or ethnic groups across countries. The use of linguistic and religious similarity is a first proxy to capture cultural similarity. A shared language, colonial history and religion reflect cultural familiarity, but they do not necessarily reflect similarity in the dominant norms and values of countries. Moreover, religion is only one factor behind cultural attitudes and values. The approach in this chapter, in contrast, directly assesses the effect of differences in cultural values and mentality. We go beyond cultural familiarity and proxies of differences in culture by focusing on cultural distance, defined as the extent to which the shared norms and values in one country differ from those in another (Hofstede, 2001; Kogut and Singh, 1988).[2] A large cultural distance raises the costs of international trade, since large cultural differences make it difficult to understand, control, and predict the behavior of others (Elsass and Veiga, 1994). This complicates interactions (Parkhe, 1991) and hinders the development of rapport and trust, thus impeding the realization of business deals. This suggests that a large cultural distance between countries reduces the amount of trade between them.

6.3 Institutions and trade

In Chapter 2, we argued that institutional distance reduces trade. This is likely to be due to increased transaction costs and reduced bilateral trust caused by widely differing institutional settings. As set forth in Chapter 2, the effect of institutional distance on trust and trade costs is similar to the effects of cultural unfamiliarity. In order to control for the effect of this institutional barrier, we explicitly include institutional distance in the analysis. A firm exporting to a foreign country with an institutional quality level comparable to that of the firm's home country is more likely to operate effectively in that institutional environment than a firm from a country with widely different institutional effectiveness. Similar institutional effectiveness is likely to result in mutual familiarity with the informal procedures of doing business. This reduces adjustment costs and insecurity in trade. Hence, we expect countries to trade more if the institutional distance between them is small (see Chapter 4). We also explicitly take into account the effect of institutional quality levels on bilateral trade, as in Chapter 4. If the rule of law is effective, and if government regulation is transparent and

[2] The assumption underlying this notion of 'culture at the national level' is that we presume some degree of national uniformity in cultural values, or mindset. This assumption, which is at the centre of much of the research on identifying cultural attributes of nations (such as the work by Hofstede [1980; 2001] that we make use of) has not remained without critique. For a recent example, see McSweeney (2002).

impartial, countries engage in more trade because the security of property and contract enforcement is higher.

6.4 Data and method

In order to assess the impact of cultural distance and institutions on trade flows, we use a gravity equation that controls for other variables influencing the amount of trade between pairs of countries. For more discussion on the gravity model, we refer to Chapter 2.

The empirical approach closely follows the argument of the previous sections. First, we extend the gravity equation with variables that reflect cultural familiarity, following the suggestions in the related literature. Specifically, the model includes dummies indicating whether the trading partners share a common language, colonial past, or common religion. In the second stage we include variables for cultural distance, institutional distance and institutional quality. Finally, we include some additional control variables to check the robustness of our results. The specification of the gravity equation that we focus on in our analysis is as follows:

$$\begin{aligned}\ln(T_{ij}) &= \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(y_i) + \beta_4 \ln(y_j) + \beta_5 \ln(D_{ij}) + \beta_6 Adj_{ij} \\ &+ \beta_7 RIA_{ij} + \beta_8 Lan_{ij} + \beta_9 Col_{ij} + \beta_{10} Rel_{ij} + \beta_{11} CD_{ij} + \beta_{12} ID_{ij} + \beta_{13} IQ_i + \beta_{14} IQ_j + \varepsilon_{ij}\end{aligned}, \quad (6.1)$$

where i and j denote the exporting and importing country, respectively. The dependent variable is the natural logarithm of bilateral merchandise exports (T_{ij}) in thousands of U.S. dollars from country i to j for 1999. The explanatory variables are the log of GDP (Y) and GDP per capita (y) in the exporting and importing country, the log of geographic distance (D_{ij}), and two dummies reflecting whether a country pair shares membership in a regional integration agreement (*RIA*), or consists of adjacent countries (*Adj*). These seven variables form the benchmark gravity equation. In addition, we include dummies taking the value of 1 if the country pair shares their primary language (*Lan*), colonial history (*Col*), or main religion (*Rel*). These variables have the purpose to capture the impact of cultural familiarity on trade. Our variables of interest are indicators of institutional quality (*IQ*) in the trading countries and their institutional (*ID*) and cultural (*CD*) distance.

Because the main emphasis of the analysis is on cultural distance and institutions, some further description of the variables for cultural distance, institutional distance and institutional quality is warranted here. The cultural distance between countries is usually assessed through the dimensions of national culture identified in Hofstede (1980; 2001) (e.g., Kogut and Singh, 1988; Barkema and Vermeulen, 1997). Analyzing survey data obtained from 116,000 IBM employees in 40 countries, Hofstede (1980) identified four dimensions along which national cultures differ:

1. Power distance, which refers to the extent to which people believe that power and status are distributed unequally and the extent to which they accept an unequal distribution of power as the proper way for social systems to be organized;
2. Uncertainty avoidance, which refers to the extent of discomfort that people feel with respect to uncertain, unknown, or unstructured situations;
3. Individualism versus collectivism, which reflects the degree to which a society emphasizes the role of the individual as opposed to the role of the group;
4. Masculinity/femininity, which refers to the extent to which a society's dominant values emphasize traditional masculine social values such as competitiveness, assertiveness, achievement, ambition, and the acquisition of money and other material possessions, as opposed to feminine social values such as nurturing, helping others, putting relationships with people before money, not showing off, and minding the quality of life.

Hofstede assigned each country a score between about 0 and 100 for each cultural dimension to indicate how people from different cultures feel about the above societal issues.[3] The number of countries covered in Hofstede (2001) has increased to over 50 countries. Data for additional countries in this chapter have kindly been made available after personal correspondence.[4] The total number of countries covered in this chapter equals 92 (see the Data Appendix). We have complete data on all explanatory variables for this set of countries. For further information on the data, and the list of countries included, the reader may consult the Data Appendix.

We use the country scores on the four dimensions of national culture from Hofstede (1980; 2001) to construct the following cultural distance measure (see Chapters 4 and 5):

$$CD_{ij} = \frac{1}{4}\sum_{k=1}^{4}\left(I_{ki} - I_{kj}\right)^2 \Big/ V_k \; , \tag{6.2}$$

where I_{ki} indicates the score on dimension k for country i and V_k indicates the variance of this dimension across all countries. This measure of distance was developed by Kogut and Singh (1988), and is often used in international business research (e.g., Loree and Guisinger, 1995; Barkema and Vermeulen, 1997; Park and Ungson, 1997; Brouthers and Brouthers, 2001).

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[3] A score close to zero indicates low extent of, e.g., power distance, whereas a value close to 100 refers to a high extent. For the individualism and masculinity indices, high scores point at high individualism and masculinity, respectively. Low scores imply more collectivist or feminine value structures. In a later stage, Hofstede and Bond (1988) uncovered a fifth cultural dimension, called ‘long-term orientation’. Unfortunately, the scores on this dimension are available for a limited number of countries only, thus reducing its empirical applicability. Moreover, scholars have questioned the added value of this dimension, as it would reflect the same underlying cultural values as the individualism dimension (see Barkema and Vermeulen, 1997).

[4] Many of the country scores in the database date back to around 1970 (see Hofstede, 2001). However, comparisons over time with other findings on cultural attributes, including more recent data, for example from the World Values Survey (WVS), reveal that the Hofstede-dimensions are strongly correlated to these alternative attributes, and that these correlations are very stable over time (see Hofstede, 2001, p. 33). The stability of these correlations over time leads Hofstede (2001, p. 36) to conclude that “[c]ulture change basic enough to invalidate the country dimension index scores will need either a much longer period (…) or extremely dramatic outside events”. Moreover, index scores depict the relative positions of countries in terms of the cultural dimensions, rather than their absolute positions, which strengthens the stability argument.

As in Chapter 4, the variables for institutional quality and institutional distance are based on the set of governance quality indicators constructed by Kaufmann et al. (2003).[5] The six indicators of institutional effectiveness are highly correlated. Therefore, we use the arithmetic average of a country's scores on all governance indicators as a composite measure of institutional quality. The indicator scores on institutional quality for 1998 were used. Like cultural distance, institutional distance is measured as a Kogut-Singh index:

$$ID_{ij} = \frac{1}{6}\sum_{k=1}^{6}\left(I_{ki} - I_{kj}\right)^2 \Big/ V_k \,. \tag{6.3}$$

6.5 Regression results

The first specification of Table 6.1 below shows the results for the benchmark gravity equation. Subsequently, the table shows the results of extending the benchmark equation with measures of cultural familiarity. We successively add dummies indicating whether the trading partners have a common language, colonial link, and a common religion.

The benchmark specification shows that, in line with previous findings, GDP and GDP per capita have positive effects on trade, while geographic distance has a negative effect. Furthermore, adjacent countries trade substantially (153%) more than non-contiguous countries.[6] This confirms the importance of geographical proximity for trade (cf., e.g., Frankel, 1997). We proxy trade policy barriers with a dummy variable that indicates whether two countries take part in a regional integration agreement. The results show that membership in a common regional integration agreement raises bilateral trade substantially as well.

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[5] These indicators are: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and corruption control. For more information on the governance indicators, see Chapter 4.

[6] The percentage trade impact for dummy variable k can be computed as $\left(e^{\beta_k} - 1\right) \times 100\%$.

Table 6.1 Gravity estimates: basic gravity model extended with cultural familiarity variables

	(1) Standard model	(2) Common language	(3) Colonial links	(4) Common main religion
Log GDP exporter	1.18***	1.19***	1.19***	1.19***
	(77.55)	(78.38)	(78.69)	(78.72)
Log GDP importer	0.94***	0.94***	0.95***	0.95***
	(59.08)	(59.76)	(60.52)	(60.54)
Log GDP/cap exporter	0.07***	0.08***	0.08***	0.07***
	(4.22)	(4.43)	(4.55)	(4.27)
Log GDP/cap importer	0.07***	0.07***	0.07***	0.07***
	(3.55)	(3.69)	(3.80)	(3.59)
Log Distance	–1.03***	–1.03***	–1.05***	–1.05***
	(40.89)	(41.49)	(42.16)	(42.14)
Border dummy	0.93***	0.76***	0.77***	0.74***
	(6.57)	(5.27)	(5.30)	(5.08)
Regional bloc dummy	0.74***	0.61***	0.55***	0.53***
	(10.99)	(9.33)	(8.54)	(8.15)
Language dummy		1.09***	0.38***	0.28**
		(14.23)	(3.52)	(2.56)
Colonial link dummy			0.98***	0.98***
			(10.42)	(10.42)
Religion dummy				0.20***
				(3.77)
Constant	–35.84***	–36.17***	–36.25***	–36.24***
	(73.38)	(74.81)	(75.06)	(75.08)
Observations	7819	7819	7819	7819
Adjusted R-squared	0.72	0.72	0.73	0.73
F-statistic	2636.48	2339.87	2099.81	1891.17

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log aggregate bilateral exports.

Cultural familiarity matters for trade. Country pairs with a similar official language, religion, and colonial past trade more, because these cultural and historical links increase the extent to which countries are familiar with each other. The effects of similarity in language, religion, and colonial past remain significantly positive when the variables are jointly included in specification (4). However, the effect size and statistical significance of the language dummy decrease substantially, if the gravity equation controls for colonial links. This reflects that countries that share their primary language often have historical colonial links as well. Adding the common religion dummy results in a similar change in the effect of language commonality, although to a somewhat lesser extent.

Table 6.2 Trade effects: a quantitative illustration

Based on Specification (4) of Table 6.1	Beta-coefficient (%)	Trade impact of dummy variables (%)†
Log GDP exporter	63	
Log GDP importer	50	
Log GDP/cap exporter	3	
Log GDP/cap importer	3	
Log Distance	26	
Border Dummy	3	110
Regional Bloc dummy	4	70
Language Dummy	2	32
Colonial link Dummy	8	166
Religion Dummy	2	22

Notes: A beta coefficient is defined as the parameter estimate times the standard deviation of the regressor, relative to the standard deviation in trade. The statistics needed to compute the beta-coefficients can be found in the table with descriptive statistics for Chapter 6, in the Data Appendix. †: The percentage trade impact of a dummy variable x_k is defined as $(e^{\beta_k} - 1) \times 100\%$.

To assess and compare the contribution of the explanatory variables to the variation in trade patterns, the first column in Table 6.2 presents the standardized coefficient, also known as 'beta' coefficient, B_{x_k} , for each regressor x_k (e.g., Helpman et al., 2004). The beta coefficient is defined as:

$$B_{x_k} = \left| \left(\frac{\beta_j \times \sigma_{x_k}}{\sigma_{\ln(T_{ij})}} \right) \right| \times 100\% . \tag{6.4}$$

It reflects the average variation in trade flows generated by the regressor, relative to the total average variation in trade flows (as measured by the standard deviation in the log of trade flows, $\sigma_{\ln(T_{ij})}$). The average variation in trade caused by the variation in regressor x_k is computed by multiplying the parameter estimate (β_k) by the standard deviation of the regressor (σ_{xk}). Beta coefficients are comparable across explanatory variables and provide an indication of the economic significance of the various effects.[7] Apart from the relative

[7] Because dummy regressor variables (such as the border dummy) can only take two values (either zero or one), the interpretation of the standard deviation as a typical, average variation in scores between pairs of observations is somewhat artificial. The beta-coefficient still applies for dummy variables, though. The second column in Table 6.2 depicts the average percentage difference in trade between both groups of observations for each dummy regressor variable.

importance of explanatory variables in explaining the variation in trade flows, we are also interested in their absolute effects on trade. The trade impact of the log-linear variables in the gravity model (the four GDP variables and geographic distance) can be inferred directly from Table 6.1. The parameter estimates reflect the elasticity of trade with respect to changes in these variables. The second column of Table 6.2 depicts the trade impact of the dummy variables as the percentage difference in bilateral trade between country pairs that share a common characteristic and country pairs that do not. Table 6.2 shows that most of the variation in trade flows follows from variations in GDP and geographic distance across countries. Although countries that share a colonial past or border trade substantially more, these factors only account for a relatively small part of the total variation in trade.[8]

Table 6.3 extends the gravity model with our variables of interest, the indicators of institutional quality, and institutional and cultural distance. Surprisingly, the effect of cultural distance on trade is significantly positive indicating that culturally dissimilar countries trade more rather than less. Section 6 below further discusses a possible explanation of this finding.

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[8] Apart from the effect-size estimate, the variance of the regressors is also important for the variation in trade that they explain. For dummy variables, this implies that the shares of 0- and 1-observations in the sample are important for their economic significance in explaining the variation in trade patterns. This explains why the beta-coefficient for the regional bloc effect is higher than that for contiguity, even though the estimated effect size is smaller. In fact, the variance of a dummy variable x_k is fully determined by its mean value $\bar{x}_k$, and reaches a maximum value of 0.25 when the mean value equals 0.5. Remember that the mean value of a dummy equals the share of 1-observations; the variance of dummy x_k then equals:

$$V(x_k) = \frac{1}{N_i N_j} \sum_i \sum_j \left(x_{kij} - \bar{x}_k \right)^2 = \frac{1}{N_i N_j} \left(\sum_i \sum_j x_{kij}^2 - 2\bar{x}_k \sum_i \sum_j x_{kij} + N_i N_j \bar{x}_k^2 \right),$$
$$= \frac{1}{N_i N_j} \left(N_i N_j \bar{x}_k - 2 N_i N_j \bar{x}_k^2 + N_i N_j \bar{x}_k^2 \right) = \bar{x}_k \left(1 - \bar{x}_k \right)$$

which lies between 0 and 0.25, with the maximum value at $\bar{x}_k = 0.5$.

Table 6.3 Gravity equations: cultural distance and institutions

	(1) Cultural distance	(2) Institutional distance	(3) Institutional quality	(4) Excluding cultural familiarity controls
Log GDP exporter	1.19***	1.19***	1.21***	1.20***
	(78.79)	(78.99)	(78.90)	(77.96)
Log GDP importer	0.95***	0.95***	0.96***	0.95***
	(60.75)	(60.61)	(61.08)	(59.85)
Log GDP/cap exporter	0.06***	0.06***	–0.16***	–0.19***
	(3.23)	(3.19)	(4.39)	(5.24)
Log GDP/cap importer	0.05***	0.05***	–0.06*	–0.09**
	(2.74)	(2.68)	(1.68)	(2.55)
Log Distance	–1.06***	–1.06***	–1.07***	–1.05***
	(42.26)	(42.35)	(42.68)	(41.49)
Border dummy	0.76***	0.74***	0.77***	0.95***
	(5.23)	(5.10)	(5.23)	(6.60)
Regional bloc dummy	0.54***	0.51***	0.44***	0.63***
	(8.28)	(7.62)	(6.71)	(9.16)
Language dummy	0.31***	0.31***	0.32***	
	(2.78)	(2.82)	(2.87)	
Colonial link dummy	0.98***	0.99***	0.90***	
	(10.45)	(10.47)	(9.52)	
Religion dummy	0.23***	0.22***	0.22***	
	(4.22)	(4.10)	(4.03)	
Cultural distance	0.06***	0.07***	0.05***	0.02
	(4.30)	(5.01)	(3.53)	(1.21)
Institutional distance		–0.03***	–0.03***	–0.03**
		(2.90)	(2.86)	(2.45)
Inst. quality exporter			0.43***	0.52***
			(7.55)	(8.88)
Inst. quality importer			0.23***	0.31***
			(4.14)	(5.53)
Constant	–36.09***	–36.13***	–34.21***	–33.44***
	(74.91)	(75.11)	(63.87)	(61.95)
Observations	7819	7819	7819	7819
Adjusted R-squared	0.73	0.73	0.73	0.72
F-statistic	1733.08	1597.79	1351.08	1667.58

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log aggregate bilateral exports.

The relation between trade and cultural distance is robust if we include institutional quality and institutional distance into the specification of the gravity equation. The results reported here are in line with Chapter 4. The quality of formal institutions has a positive effect on the amount of trade, presumably because high-quality institutions enhance property security and contract enforceability, and reduce the costs of trade. Institutional distance is negatively related to bilateral trade. This suggests that traders indeed incur additional transaction costs if they are not familiar with the institutional environment of foreign trading partners (see Chapter 4).

Except for GDP per capita, the benchmark gravity variables are robust to the inclusion of institutional quality, and cultural and institutional distance (see also Chapter 4). The sign reversal of GDP per capita indicates that the benchmark gravity equation suffers from omitted variables bias with respect to institutional quality. After institutional quality has been controlled for in the gravity equation, the effect of GDP per capita reflects a structural feature of (wealthier) countries. The share of services in output and expenditures increases with the level of economic development. As a result, the share of expenditures on traded merchandise decreases with a country's GDP per capita (Anderson and Marcouiller, 2002).

The cultural familiarity variables remain positively and significantly related to trade. Apparently, language and colonial ties, religious similarities and cultural distance all reflect distinct channels through which culture affects trade patterns, suggesting that our distinction between cultural familiarity and similarity (or distance) makes sense. In fact, specification 4 shows that the cultural familiarity variables strengthen the effect of cultural distance in terms of size and statistical significance. This is intuitively clear, as cultural familiarity is likely to decrease with cultural distance. The correlation between the cultural familiarity and cultural distance variables generates omitted variables bias if either type of culture variables is not included. It is noteworthy that the effect of religious similarity on trade is positive, which is in contrast to the effect of cultural distance. Although religion is an important determinant of cultural values and attitudes, religious similarity and cultural distance appear to reflect different aspects of cultural values and have a separate effect on trade.

Table 6.4 below quantifies the trade effects for the extended gravity equation, including cultural familiarity variables, cultural distance, institutional distance and institutional quality. The variation in trade flows accounted for by the average variation in cultural distance, institutional distance, and institutional quality is between 2 and 10 percent. The variation in trade explained by cultural distance is approximately the same as that explained by common language, religion and adjacency, but is only about one fourth of the variation explained by a colonial history. To the extent that a common language, religion, and colonial history reflect cultural familiarity, this suggests that cultural familiarity accounts for more variation in trade flows than cultural distance.

Table 6.4 Trade effects: a quantitative illustration

Based on Specification (3) of Table 6.3	Beta-coefficient (%)	Trade impact of dummy variables (%)†
Log GDP exporter	64	
Log GDP importer	51	
Log GDP/cap exporter	7	
Log GDP/cap importer	3	
Log Distance	26	
Border Dummy	3	116
Regional Bloc dummy	3	55
Language Dummy	2	38
Colonial link Dummy	8	146
Religion Dummy	2	25
Cultural distance	2	
Institutional distance	2	
Institutional quality exporter	10	
Institutional quality importer	5	

Notes: A beta coefficient is defined as the parameter estimate times the standard deviation of the regressor, relative to the standard deviation in trade. The statistics needed to compute the beta-coefficients can be found in the table with descriptive statistics for Chapter 6, in the Data Appendix. †: The percentage trade impact of a dummy variable x_k is defined as $(e^{\beta_k} - 1) \times 100\%$.

As in Table 6.2, the last column of Table 6.4 shows the impact of sharing a common characteristic (such as physical borders, language, or main religion) on trade. Because the indicators for cultural and institutional distance, and institutional quality are included in the gravity equation in a semi-logarithmic functional form, their trade impacts cannot be interpreted as straightforwardly as a dummy impact or a double-log elasticity. The trade impact of these variables is represented as the effect on trade of an increase of one standard deviation in the regressor.[9] The standard deviation provides an accurate description of the typical variation between country pairs in these variables (see Chapter 4). Based on

[9] The percentage trade impact of increasing regressor variable xk by one standard deviation equals $\left(dT_{ij}/T_{ij}\right) \times 100\% = \left(e^{\beta_k \times \sigma_k} - 1\right) \times 100\%$.

specification (3) in Table 6.3, trade in a country-pair of which the cultural distance is one standard deviation above average, generally exceeds trade in an average country pair by 8%. A one standard deviation increase in institutional quality on average raises bilateral exports from that country by 45% and bilateral imports into the country by 22%. Finally, an increase in institutional distance of one standard deviation leads to an average fall in trade of 6%.

6.6 Discussion

Although the effects of institutional quality and institutional distance on bilateral trade are as expected, this is not the case for the effect of cultural distance, as we find it to be positive rather than negative. The trade-off between different modes of serving foreign markets may provide an explanation for this counterintuitive result. A firm can either export or start up local production to supply its products to a foreign host market. Depending on the size of various transaction costs and the importance of scale effects, exporting or local production through horizontal foreign direct investment (FDI) is preferred (see, e.g., Helpman et al., 2004; Brainard, 1993). Evidence from the international business literature suggests that firms are reluctant to produce their goods in countries that are culturally distant from their home country, and therefore prefer to trade with such countries instead. Although the costs of international trade are likely to increase with cultural distance, the costs of managing employees abroad through a production subsidiary are likely to increase even faster. This is because, compared to trade, local production requires closer interactions with a wider variety of local stakeholders such as employees, unions, suppliers, and government agencies (Hennart, 2000; Johanson and Vahlne, 1977). The larger the cultural distance between two countries, the larger the differences in their organizational and management practices (Kogut and Singh, 1988). These differences make the transfer of home-country practices to production subsidiaries located in culturally dissimilar environments difficult and costly. Although these subsidiaries could try to adopt the host-country's prevailing practices instead, the learning costs associated with this process in terms of time, effort, and resources are likely to be too high (Madhok, 1998).

Because of the high costs and uncertainty of successfully operating production facilities in culturally distant countries, firms expanding into such countries tend to opt for entry modes requiring relatively little resources, such as exporting (Dunning, 1993). Thus, the positive effect of cultural distance on trade may be explained by the fact that, although the costs of trade increase with cultural distance, those of host-country production increase even more, leading firms to prefer trade to host-country production. In order for bilateral exports to increase with cultural distance, the substitution of host-country production by trade has to be large enough to compensate for the direct effect on exports of high trade costs. An explicit examination of the existence of this substitution effect would require data on the sales of firms' foreign production affiliates, but these are not readily available, unfortunately.

Since institutional distance and low-quality institutions reduce bilateral trade, the substitution effect between trade and local production appears to be less pervasive. Apparently, transaction costs of trade rise equally fast as those of FDI sales. Regarding institutional quality, contracting costs and property risk are lower for FDI sales, because they do not cross borders (Rodrik, 2000). However, repatriation of profits and other financial flows related to FDI are equally at risk as international goods transactions. Because the investment costs associated with FDI are partly sunk costs, the risk of opportunistic behaviour or expropriation is high in countries that have low institutional quality. This suggests that institutional quality affects the costs of FDI sales and exports similarly. Low institutional quality reduces the size of bilateral transactions across the board, with no evident sign of composition effects between exports and FDI sales. This is supported by empirical evidence on the effect of institutional quality on both FDI (e.g., Globerman and Shapiro, 2003) and trade (Anderson and Marcouiller, 2002).

The transaction costs of institutional distance are related to property security and the enforceability of contracts as well. The risks and costs of unfamiliarity with the institutional environment are therefore high for exports as well as for FDI. The scope for substitution between FDI sales and trade may hence be smaller. For example, whereas cultural distance is inconvenient for trade and requires adjustment costs depending on the intensity of interaction, institutional distance affects transactions even when they remain 'at arm's length' (see Chapter 5). As a result, substitution from FDI sales to exports need not compensate for the direct effect of increased trade costs on exports.

6.7 Sensitivity analysis

To test the robustness of our results, we add several geographic characteristics of the trading countries to the gravity model. The geographic variables included in Table 6.5 are, respectively, the log of the product of surface areas of the trading partners and four dummy variables indicating whether the partners are landlocked or island nations. These variables have been introduced to the gravity model before to capture physical trade costs (e.g., Rose, 2004; Raballand, 2003). The importance of physical geography has been illustrated by Gallup et al. (1999), who show that these variables matter for transport costs margins in trade and ultimately for cross-country productivity differences. In particular, because land and air transport of especially bulk goods is often more expensive than water transport (Frankel, 1997), a large combined land area increases total transport costs. Landlocked or island nations are differentially affected by trade costs as well.

Table 6.5 shows the results of our robustness extensions of the gravity model. The estimated coefficients for the geographic control variables in Table 6.5 conform to the expectations and the institutional and cultural variables are qualitatively robust to these extensions. The size of parameter estimates differs somewhat across specifications, though.

Table 6.5 Gravity estimates: robustness to geographical factors

	(1) Surface area	(2) Landlocked-ness	(3) Islands	(4) all geographical controls
Log GDP exporter	1.28***	1.19***	1.22***	1.27***
	(65.01)	(77.10)	(76.53)	(62.91)
Log GDP importer	1.03***	0.94***	0.97***	1.01***
	(51.08)	(60.00)	(58.28)	(49.36)
Log GDP/cap exp.	–0.24***	–0.23***	–0.17***	–0.32***
	(6.23)	(6.47)	(4.73)	(8.41)
Log GDP/cap imp.	–0.14***	–0.14***	–0.07**	–0.23***
	(3.71)	(4.06)	(1.97)	(6.03)
Log Distance	–1.05***	–1.11***	–1.09***	–1.10***
	(41.29)	(44.37)	(42.58)	(42.37)
Adjacent countries	0.82***	0.80***	0.77***	0.85***
	(5.49)	(5.40)	(5.18)	(5.66)
RIA dummy	0.46***	0.41***	0.44***	0.42***
	(7.07)	(6.26)	(6.59)	(6.59)
Language dummy	0.37***	0.27**	0.32***	0.33***
	(3.37)	(2.48)	(2.85)	(3.00)
Colonial link dummy	0.86***	0.78***	0.84***	0.72***
	(9.12)	(8.25)	(8.86)	(7.65)
Religion dummy	0.22***	0.25***	0.22***	0.26***
	(4.14)	(4.77)	(4.11)	(4.91)
Cultural distance	0.05***	0.06***	0.05***	0.06***
	(3.51)	(3.97)	(3.26)	(3.91)
Institutional distance	–0.03***	–0.03**	–0.03***	–0.02**
	(2.82)	(2.40)	(2.73)	(2.33)
Inst. quality exporter	0.44***	0.58***	0.43***	0.58***
	(7.64)	(9.83)	(7.54)	(9.87)
Inst. quality importer	0.23***	0.39***	0.23***	0.40***
	(4.24)	(6.77)	(4.15)	(6.89)
Log area-product	–0.07***			–0.08***
	(6.30)			(6.62)
Landlocked exporter		–0.57***		–0.57***
		(7.68)		(7.55)
Landlocked importer		–0.64***		–0.65***
		(8.77)		(8.81)
Island exporter			0.33***	0.12
			(2.90)	(1.05)
Island importer			0.25**	0.01
			(2.44)	(0.14)
Constant	–34.88***	–31.36***	–34.57***	–32.12***
	(62.60)	(55.45)	(63.41)	(54.06)
Observations	7819	7819	7819	7819
Adjusted R-squared	0.73	0.74	0.73	0.74
F-statistic	1253.87	1203.47	1175.63	1006.21

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable: log aggregate bilateral exports.

6.8 Conclusion

This chapter has examined whether cultural distance affects the patterns of bilateral trade. Previous studies have already addressed the role of language, religion, and colonial history for trade. This chapter argues that these variables only capture cultural familiarity. Using Hofstede's (1980; 2001) four dimensions of national culture, we have analyzed the effect on bilateral trade of cultural distance, reflecting differences in cultural values and norms. We find that cultural distance has a positive effect on bilateral trade. This finding is surprising, as we have argued that a large cultural distance raises the costs of trade. Literature on international business relations suggests that the transaction costs that ensue from cultural distance are most prominent when the degree of interaction with foreign agents is high. As a result, the costs related to cultural distance may lead to a substitution effect from more involved modes of entry on foreign markets toward less involved modes, such as exports. Therefore, a potential explanation for the finding that cultural distance increases trade is that firms prefer trade to host-country production in culturally distant countries. We have not tested this hypothesis empirically within the context of this chapter. Hence, further research is required to substantiate this claim.

The results in this chapter furthermore confirm the relation between institutions and trade patterns found in Chapter 4 of this thesis. Institutional distance has a negative effect on bilateral trade, presumably because the transaction costs between partners from dissimilar institutional settings are high, both for exports and for local production through a foreign subsidiary. Moreover, we find that the institutional quality in both the import and export country increases the amount of bilateral trade. These results are robust to adding cultural distance as additional trade costs determinant.

Part III

Retrospect and Prospect

Chapter 7

Conclusion

7.1 Introduction

At the beginning of this thesis, we considered the potential benefits of trade between different countries. The incentives for trade abound, given the differences in technology and resource endowments between countries, and the potential to take advantage of scale economies and to increase the available variety of products for consumption. Moreover, technological advances in transport and communication and substantial liberalization of trade have contributed to a fast pace of growth in trade over the past 50 years, and will potentially enable the realization of further gains from international economic integration. Despite the incentives for trade and the rapid growth in trade, trade volumes remain surprisingly low, however (see Trefler, 1995; Eaton and Kortum, 2002). This suggests that trade barriers are persistent, and substantially raise the costs associated with international trade. The resistance to trade generated by national borders and physical distance appears to be too high to be explained by the traditional, tangible barriers to trade, such as transport costs and tariff barriers (Anderson, 1999). As argued by Deardorff (2004), trade patterns are, for a large part, determined by mostly unobserved trade costs. Thus, to explain the observed patterns of bilateral trade, less visible barriers are important as well. The purpose of this thesis was to identify the underlying relations between intangible barriers and the patterns of bilateral trade, and to investigate the importance of these barriers for trade flows. Three research questions were introduced in

Chapter 1 to serve as guideline for the analysis. These questions are repeated here to serve as the background against which to draw our conclusions.

1. What explains the variation across the literature in the effect of physical distance on bilateral trade and has the effect decreased over time as a consequence of falling costs of transport and communication?

2. What are the relevant intangible dimensions of economic distance between countries that affect the intensity of trade?

3. Does the importance of intangible barriers to trade at a more disaggregate level depend on market conditions, in particular the degree of product differentiation?

The remainder of the concluding chapter is organized as follows. The first section summarizes the research results. Subsequently, section 7.2 returns to the research questions and discusses some of the implications of the answers that we found to these questions. Sections 7.3 and 7.4 discuss the implications for policy discussions and provide some suggestions for further research by identifying some of the issues that remain to be further investigated.

7.2 Summary of research results

Chapter 1 introduced the main barriers to trade investigated in this thesis. First, we referred to physical distance, as a reflection of both tangible transport barriers and intangible barriers related to incomplete information and cultural familiarity. The thesis investigates two types of intangible barriers to trade in particular: institutional barriers related to insecurity of property rights and contract enforcement, and cultural barriers related to differences in underlying cultural values and norms. Chapter 2 provided a further discussion of these trade barriers. Central to the importance of intangible barriers to trade is the notion that it is difficult, in cross-border exchange, to engage in successful cooperative behaviour and realize the potential mutual benefits (e.g., Granovetter, 1985; Greif, 2000; Dixit, 2004). There are several dimensions to this 'fundamental problem of exchange' across borders. First, because international trade crosses jurisdictional borders, property rights and the enforcement of contracts are generally less secure (Rodrik, 2000). As a result, trade faces an insecurity barrier, which is lower if trade is supported by transparent and impartial government regulation and by an effective rule of law, hence by a good quality of the institutional framework. Homogeneity in the effectiveness of institutions may also reduce bilateral trade costs associated to the insecurity barrier. Because they are familiar with the level of institutional protection of trade, agents from both countries are better able to adjust to the institutional setting, and have more confidence in successful cooperation, which reduces transaction costs. Second, the potential for mutually beneficial trade is often not appreciated because of a lack of trust in conducting bilateral trade. Partly, trust is related to the level of security of trade, and is influenced by variation in institutional quality across countries. This is mostly formal, calculated trust, or confidence, based on the expected objective pay-offs from cooperation and defection (Nooteboom, 2002). Aside from that, bilateral trust levels depend on cultural differences. If a foreign country is unfamiliar, or distant in terms of values and norms, intensive face-to-face communication may be lacking, as well as bilateral understanding and endorsement of the conventions and procedures of business. Difficulties of communication and uncertainty about perceptions on internalized norms of behaviour, lead to a reduction in both formal and informal bilateral trust. In other words, the equilibrium payoff from transactions between agents who differ in terms of values and domestic institutional environment is lower (Poot, 2004). Thirdly, the border barrier in trade reflects that information on foreign markets is incomplete and costly to acquire. Familiarity and information density tend to fall with physical distance, generating subjective resistance to trade that has also become known as 'psychic' or 'mental' distance in trade (see, e.g., Frankel, 1997). As a result, search and adjustment costs in foreign trade are relatively high and increasing in physical and psychological distance. Finally, cultural distance, in terms of differences in underlying values and norms, also affects adjustment and cooperation costs, because these differences translate into different ways of doing business and reduce the ability to understand, control and predict the behaviour of others.

Next, Chapter 2 introduced the empirical model used for the empirical analysis of trade barriers in the subsequent chapters. The ‘gravity model’ of bilateral trade owes its name to Newton’s model in physics in which the gravitational force between two bodies positively depends on the mass of those bodies and negatively on their distance. In its most simple form, a gravity model in international trade defines the bodies as countries, uses GDP to reflect ‘mass’, and proxies distance by distance between the capitals of the respective countries. Apart from being successful empirically, the gravity model in international trade has more recently also received theoretical support and is firmly based within a variety of trade theories (e.g., see Deardorff, 1998). Typical applied papers in the field of international economics elaborate on the before mentioned most simple form of the gravity model and incorporate other proxies for mass and distance. This thesis follows that approach and extends the gravity equation to be estimated with indicators of institutional quality, institutional distance and cultural distance.

Chapters 3 to 6 aimed to empirically investigate the effect of these intangible barriers on bilateral trade patterns. Geographical distance is related to some of these intangible barriers, notably cultural and informational barriers to trade. The size of the distance effect estimated across the literature is usually large and the effect is fairly stable over time. In light of the continuous improvements in transport facilities, this suggests that intangible barriers to trade explain most of the distance decay in trade. Chapter 3 analyses the evidence in the literature on the effect of physical distance on trade, using methods of meta-analysis. Meta-analysis refers to the methods used for quantitative analysis of a body of empirical evidence on a specific topic, in order to synthesize the available evidence and draw statistical conclusions on the true underlying relations. The results from the meta-analysis on a representative sample of the literature confirm that the distance decay elasticity is substantial, at a weighted average of 0.78 (positively defined). This implies that bilateral trade on average falls by roughly 0.8% for each 1% increase in distance. The estimates of distance decay vary across the literature, though. Meta-regression analysis shows that a substantial part of this variation can be explained by differences in estimation and specification characteristics. For example, the estimate varies depending on whether various control variables have been included in the primary studies. Most interestingly, the regression results indicate that distance decay has risen in magnitude over time. Controlling for other differences across distance decay estimates, the effect has risen by about 0.2 percentage points over the last century, which is a rise of 30% compared to the value at the beginning of that period. Given the fall in transport costs and communication costs, this finding is surprising. The relative importance of distance-sensitive costs does not appear to have fallen, compared to marginal production costs and other transaction costs.

The effect on trade of variation in the quality of institutions across countries was the focus of Chapter 4. The quality of formal institutions affects the security of property and contract enforcement in trade. If property rights and contractual arrangements are supported by an effective and independent rule of law, and government regulation is transparent and impartial, international trade is more secure. Apart from this, firms will be better able to operate in a foreign country if they are familiar with the institutional framework in that country. Thus, firms that domestically operate in a poor institutional environment will have better capabilities to deal with insecurity abroad informally. On the other hand, firms that are used to the regulations, procedures and requirements that come with tight formal protection, will more easily meet all the contracting and bureaucratic standards. Alternatively, as the difference in institutional quality rises between countries, this poses a higher barrier to their mutual trade. Therefore, we separately distinguished the effects of quality levels and bilateral quality differences of the institutional framework, using institutional indicators compiled by Kaufmann et al. (2003) from survey and interview data on perceived institutional quality. The results show that both aspects of the institutional setting are important for bilateral trade. For institutional quality, we find that if the overall quality level in a country is one standard deviation above average, that country will *ceteris paribus* export 50% more to any country, compared to a third country with average institutional quality. Raising the institutional quality of the importing country one sample standard deviation, leads to 37% more bilateral import by that country. The effect of institutional distance was measured in various ways. Several dummy variables characterized countries as institutionally heterogeneous, if the bilateral quality difference exceeded a specific demarcation point. If the cut-off point of institutional heterogeneity is for differences exceeding two standard deviations, countries trade 27% less, on average, if they classify as heterogeneous in terms of institutional effectiveness. The alternative dummies at different demarcation points show that larger institutional differences reduce trade more. To capture the incremental effect of rising institutional distance, we defined a continuous measure of institutional distance. The results reveal that increasing institutional distance one standard deviation reduces bilateral trade by an estimated 12%. Summarizing, the impact of institutional quality and institutional distance indicates that the insecurity barrier appears to have a substantial effect on trade flows. We can consider the effects of institutional quality and institutional distance as robust evidence for the importance of trust and security in trade, because the results are robust to other trade barriers (such as tariff barriers and Linder-style differences in preference, that may be correlated to [differences in] institutional quality levels).

Chapter 5 analysed whether the effect of institutional trade barriers differs at a disaggregate level of trade, between different categories of products. We have noted in Chapter 2 that aspects of the relation between the intangible barriers to trade, considered in this thesis, and trade are interrelated. In particular, incomplete information and insecurity of trade are related. The interaction between informational and institutional barriers to trade can be observed by investigation of trade patterns at a disaggregate level. The analysis compared bilateral trade patterns in three types of products. Homogeneous products comprised those traded on organized exchanges and reference-priced products; the third group of products consists of differentiated products. Because of incomplete information, traders have to incur search costs and make investments to enter a foreign market (Romer, 1994; Rauch, 1999). For differentiated goods, the costs of search and adjustment to potential trading partners are higher, since different varieties within a product class differ in terms of many product characteristics and cannot be traded on an organized exchange or compared on the basis of prices alone. The costs of search and match imply that agents invest in trade relations for the purpose of repeated interaction that continues over time. The use of international business networks to facilitate search often supplements or replaces the price mechanism in differentiated goods trade, compared to trade in homogeneous products. This led Rauch (1999) to expect that cultural familiarity would be more important for differentiated-products trade. Because of relatively high relation-specific sunk investments in search, match and adjustment between trade partners, the risks and costs of opportunistic behaviour are higher for differentiated goods (see Caballero and Hammour, 1996). Because international network relations do not suffice to enforce cooperative behaviour in international transactions (Rodrik, 2000; Dixit, 2004), we expected that the quality and distance of institutions would be more important for trade in differentiated products as well.

Since the analysis in Chapter 5 focused on disaggregated trade, the problem of zero-valued bilateral trade flows emerged more prominently. These flows pose difficulties in estimation and theoretical explanation. First, the log linear gravity model cannot include zero-trade, because the log of zero is undefined. Second, the gravity model predicts that all countries trade with all others and cannot explain true zero flows. However, we did not discard the gravity model in the empirical analysis, but tried to supplement the model with a separate description of the decision whether or not to enter into bilateral trade, to explain zero flows. This decision is based on profitability of transactions at the microeconomic level, and can be motivated by the assumption that fixed costs have to be incurred to enter a foreign market (Romer, 1994; Anderson and Van Wincoop, 2004). A sample-selection model was introduced to account for zero flows. The gravity equation describes trade if observed, whereas a selection equation (based on a latent profitability variable) includes the same explanatory variables to explain the occurrence of zero flows. The model allows correlation between both decision stages, because unobserved effects on profitability can be expected to affect the size of the flows as well.[1]

The results confirmed that institutional quality matters most for differentiated-goods trade. There was no empirical support for the hypothesis that institutional distance is more important for differentiated products, though. It is also noteworthy that institutional quality and institutional distance are important as well to explain the occurrence of zero-flows from the selection part of the model. Interestingly, the importance of exporter institutional quality for profitability is roughly comparable across product categories, whereas the quality of importer institutions matters more for differentiated products. Also, the institutional quality of the importing country does not appear to affect the size of bilateral trade in organized-exchange goods, while exporter institutions do matter. This may suggest that the security of the supply and transport chain from the exporting country to the importing country is an important element in explaining the relevance of institutions in the exporting country. The costs involved with this type of insecurity are relevant just as well for establishing bilateral trade in homogeneous products as in differentiated goods. The sunk search and matching costs for entering the importing market, however, appear to be more relevant to differentiated products, supporting our arguments. Chapter 5 also provides evidence that most approaches conventionally used to deal with zero flows in bilateral trade, including censored regression approaches, are not robust and do not have a sound theoretical basis.

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[1] Because the three product groups are sufficiently aggregate, we believe that each contains sufficient different products for the theoretical fundamentals of complete specialization to hold. Some degree of incomplete specialization seems to be relevant, though, in particular for products traded on an organized exchange. Two arguments can be made to defend the applicability of the gravity equation here. First, if the product group of organized exchange goods includes sufficiently many products, bilateral trade can still be described by the gravity model, especially if we extend the model with a selection equation as in Chapter 5. Second, one may argue that all products, even ‘homogeneous’ products, are in some sense differentiated (see Anderson and Van Wincoop, 2004, p. 707). Differentiation for physically standardized products, such as those traded on an organized exchange, could refer to terms of delivery and the quality of the supply chain. In this view, product differentiation is a matter of degree, with ‘differentiated products’ being differentiated on most dimensions. This would, for example, help explain why Chapter 5 finds that cultural familiarity variables also affect trade in organized exchange products, and sometimes even strongly so (as with colonial links).

The impact of cultural distance on trade is the central topic of Chapter 6. Most existing literature on the effect of cultural differences focuses on cultural familiarity aspects, related to language, (colonial) history and geographic distance. However, a foreign culture can be familiar yet distant in terms of underlying values and informal norms. These differences impose barriers to interaction, because they hinder the development of rapport and trust, and reduce bilateral understanding and predictability of behaviour (Elsass and Veiga, 1994). Data on work-related cultural values and norms, collected by Hofstede (1980; 2001) on the basis of survey research, allow us to identify the effect of cultural distance barriers on bilateral trade. Surprisingly, the findings from regression analysis indicate that trade rises with cultural distance, even though the costs of trade between culturally distant countries are arguably high. A one standard deviation rise of cultural distance raises bilateral trade by an estimated 8%, on average. Widening the scope of our analysis, from trade to foreign direct investment (FDI), suggests a possible explanation. When firms consider entering a foreign sales market, they have the option to do so by means of export from the home country, or by installing productive capacity in the host market through horizontal FDI. Theories of horizontal FDI argue that the decision involves a trade off between proximity to the sales market and concentration of production (e.g., Brainard, 1993; Feenstra, 2004). If production is subject to economies of scale at the establishment level, a firm prefers to expand its sales abroad by exports. In this way, production can be concentrated in fewer locations, and scale effects can be exploited. Alternatively, if transport and other trade costs to a specific market are high, firms at some point prefer to enter that market via horizontal FDI to produce and sell locally and minimize trade costs. This hypothesis suggests that bilateral FDI may increase with geographic distance, for example. However, empirical studies tend to find that distance negatively affects bilateral FDI (see Loungani et al., 2002). Apparently, barriers that raise trade costs also raise the costs of installing and operating foreign subsidiaries. In the case of cultural barriers, we argue that cultural distance raises the relative costs of FDI sales compared to exports, because the costs, risks and resource commitments involved in FDI are higher (e.g., Johanson and Vahlne, 1977; Root, 1998; Hennart, 2000). Cultural unfamiliarity and institutions, on the other hand, mainly affect the costs of entering on a market as such, irrespective of the form of international business. Thus, even though cultural distance barriers increase trade costs, substitution from FDI sales to export can lead to an overall increase in bilateral trade.

7.3 Concluding remarks with respect to the research findings

Looking back at the research questions set forth in Chapter 1, the empirical results allow us to draw some conclusions. The first research question focused on the variation in the size of distance decay in trade across the literature and on the question whether distance has become less important for trade patterns over time. The outcomes in Chapter 3 indicate that, even though estimates vary according to the estimation and specification characteristics, the magnitude of the distance effect in trade is consistently large and has even increased over time. The implications of these findings are that statements about the "death of distance" are premature and provide support for the suggestion that the distance-related psychological resistance to trade has not eroded with improved possibilities for transport and communication. A further explanation may be that transport costs have fallen relatively most for short-distance trade.

The second research question asked what intangible barriers to trade can be identified that impede bilateral trade. In Chapter 2, we argued that institutional and cultural barriers are important determinants of bilateral trade. The results from the empirical analysis in Part 2 of this thesis provide support for the view that the intangible barriers to trade suggested before help explain why the resistance to trade remains large, offering insights in the true mechanisms that explain variation in bilateral trade. For example, Chapter 4 shows that, if we include measures of institutional effectiveness in an otherwise standard gravity model, they turn out to correct for omitted variable bias on the estimated effect of per capita GDP on bilateral trade. Hence, institutions are dominant in explaining why rich countries trade more: their effectiveness in the defence of property rights decreases the insecurity of international transactions, and lowers transaction costs.

To investigate the hypothesis that institutions and culture are important for trade, the concrete empirical question to be studied then asks how important the specific barriers are, in terms of their effect on trade. On top of the quantitative evidence already discussed in section 7.1, Chapter 6 provides a further illustration of the quantitative importance of the various intangible barriers for explaining the variation in trade flows, using the so-called beta-coefficients. This measure expresses, for each explanatory variable, the share of the variation in (log) trade across the sample that is on average accounted for by the variation in that explanatory variable (see Helpman et al., 2004). Cultural unfamiliarity barriers and information barriers, related to geographical distance, language and colonial history appear to be very important. Variation in physical distance on average accounts for a variation in bilateral trade that amounts to 26% of the standard deviation in trade. Language and colonial ties account for an additional 2% and 8%, respectively. Cultural distance represents a further 2% variation. If we consider religious differences as an alternative measure of distance in cultural values, this aspect of cultural distances claims 2% of total variation in trade as well. Largely subjective factors, such as cultural misperceptions, trust and mistrust, contribute to explaining these effects (see, e.g., The Economist, 2005). Variation in the insecurity barrier across countries explains an important part of the variation in bilateral trade as well. Up to 15% of the average variation in trade can be attributed to variation in the level of institutional quality on the export and import side. Additionally, institutional distance results in 2% of trade variation, on average.

The third research question asked whether the importance of intangible barriers differs according to the type of product traded at a disaggregate level. The analysis of the impact of trade barriers at a more disaggregate level serves to enhance our understanding of the mechanisms by which intangible barriers impose trade costs and influence trade patterns, as well as the interaction between different barriers to trade. Chapter 5 focused on this question, investigating whether institutional quality and institutional distance are more important for differentiated-goods trade than for trade in homogeneous products. The general idea behind this question is that less effective institutions affect the insecurity of contract enforcement and the transaction costs more for differentiated products, because more specific investments have to be made for trade in differentiated goods. The results provide support for this hypothesis. This suggests that the impact of incomplete information and institutional barriers reinforce each other, depending on the nature of product markets, more specifically, on the extent of product differentiation.

7.4 Policy implications

From a policy perspective, the empirical results underline the relevance of investing in good governance, or high-quality institutions, in order to increase the potential to benefit from international trade. Effective and transparent legal and policy institutions not only benefit investment and growth directly, but also through their effect on trade. Extra welfare gains and even more growth can be realized, as argued in Chapter 1. Institutional and cultural barriers also play an important role in assessing the consequences of the extension of the European Union. Most (candidate) accession countries have already abolished many of the tangible policy barriers to trade before entry to the Union, signing free trade agreements with the EU. Therefore, not much gain can be expected for these countries (nor for the incumbent EU countries) from further reduction of trade policy barriers. However, the requirement of institutional convergence by the accession countries to EU standards can generate extra gains from trade by reducing intangible barriers. An experiment that raises institutional quality levels of the Eastern European accession countries to the average in the European Union provides an illustration. The recent enlargement may raise exports from the new countries to the EU by 25-104%, and imports from the EU by 19-73%, due to institutional convergence. The increase in bilateral trade provides an argument in favour of full membership of countries bordering the incumbent EU, instead of restricting the economic ties to free trade agreements. Thus, extension of the EU is not only a political process. Real economic gains can follow from further extension, for both the entrant countries and the current members.[2] On the other hand, the findings in this thesis also reveal the limits to lowering trade barriers between the EU and its neighbours. Cultural barriers are likely to persist, whether or not new countries enter the Union. The popular reactions to the (potential) accession countries are a clear testimony of this, just as the recent constitutional crisis in the EU. These barriers not only limit the economic gains from further political and economic integration, they also influence the political dimension of integration itself.

An interesting issue with regard to intangible trade barriers, from the point of view of policy perspectives, is whether the barriers are related and what is their ultimate cause. In Chapter 2, we already discussed possible interrelations and the implications for the empirical approach to be followed. Here, we focus on the implications for policy. Institutions are man-made, and can be subject to (economic) policy, which in principle implies that improvements of the institutional support of trade are within reach. However, institutions can be shaped by cultural or geographical circumstances. For example, Acemoglu et al. (2001) argue that benevolent geographical conditions (mostly related to climate) led to permanent settlement by colonists, and the implantation of good (i.e., 'Western') institutions, promoting economic development and trade (see Poot, 2004). Moreover, bad geography (in terms of climate, inland waterways, and distance to the coast) can seriously increase transport costs, reduce productivity (see Gallup et al., 1999), and reduce the possibilities for trade. As shown by Wei (2000), countries in such unfavourable circumstances do not have the incentive to invest in

[2] These figures are based on the regression parameters for institutional quality in Table 4.3, and the gap in institutional quality between accession countries and the EU average, just before accession. These are, respectively, 0.48 for exporter institutions and 0.37 for the importing country. Institutional quality in the accession countries varies between –0.15 to 0.86, while the EU average (excluding Belgium and Luxemburg) is 1.33 (source: Kaufmann et al., 2002). The estimated increase in exports and imports of the accession countries hold with respect to any trade partner, not only to trade with the EU. In other words, these effects do not involve trade diversion for the accession countries, from non-EU partners to EU partners. However, trade diversion may occur for other countries, because they are faced with changes in the attractiveness of the accession countries, relative to all other countries. Still, the improvements in institutional quality entail welfare gains across the board.

good institutions to support trade, in contrast to countries that are naturally more open. Cultural attributes can also influence the development of institutions. Individualistic societies invested more in formal institutions to defend trade, according to Greif (1994). Furthermore, Hofstede (2001) mentions the close correlation between the incidence of corruption and the extent of hierarchical power structure in a society. The relation can also be the reverse, with institutions influencing the development of cultural values and norms (see Tabellini, 2005).

If geographical and cultural factors shape the incentives for institutional change, policy intervention is difficult and costly, and the benefits of institutional change are smaller as well. Cultural and geographical constraints are hard to amend or overcome. Moreover, the existing institutional structure may serve particular vested interests with considerable political power, who loose from institutional change (Olson, 1982; Anderson and Marcouiller, 2005). Therefore, the transition costs of institutional change may be prohibitive in the existing status quo (Khan, 1995), unless some external event triggers the need for change. Such an event may be the fall of a government, the dismantling of old power structures, as in Eastern Europe in 1989, or the pressures of globalization. When the balance of costs and benefits shifts, improvement of institutional quality can result in large economic gains, even for countries that are culturally or geographically inward looking.

7.5 Further research

Given the importance of increasing our understanding of the resistance to trade, many issues are worth further investigation. The further analysis of the size and development of the distance effect in trade seems warranted. Explicitly accounting for information variables, such as bilateral telephone traffic leads to a lower distance effect in trade (Portes et al., 2001). These relations may reflect cultural familiarity and existing network ties more directly than the distance variable, although one may wonder whether the underlying unfamiliarity is not partly caused by physical distance. In any case, this suggests that reducing the barriers to information flows may reduce unfamiliarity and incomplete information barriers (Loungani et al., 2002). But, why hasn't the effect of distance on observed patterns of trade shown a clear downward trend, then, given the developments in ICT of the past decades?

New insights on the relation between trade barriers and trade flows have also been offered by theoretical developments in so-called 'new economic geography', or 'geographical economics' (e.g., Fujita et al., 1999; Brakman et al., 2001). These theories stress the importance of economic geography, reflected by backward and forward linkages and trade barriers, for trade and income levels (Redding and Venables, 2004). An interesting implication of new economic geography (NEG) models is that, depending on the initial situation, reductions in trade barriers may lead to increased agglomeration and less trade between core and peripheral economies. Thus, smaller barriers may have bigger effects in these models. They may prove helpful to analyse the development of distance decay and the persistence of the effect of trade barriers. Much work still has to be done to translate the theoretical models in reduced forms for empirical application. For example, gravity-like equations based on structural NEG models yield ambiguous conclusions with respect to the sign of the distance effect (e.g., as reported in Brakman et al., 2001). Still, the number of studies that derive or apply gravity models inspired by theoretical insights from new economic geography is rising (e.g., Eaton and Kortum, 2002; Loungani et al., 2002; Redding and Venables, 2004). An important issue for further development is the specification of trade barriers in the gravity model. As currently modelled, the iceberg formulation of transaction costs may be too restrictive (Anderson and Marcouiller, 2005). Moreover, the specification of the relation between trade barriers and the trade cost mark-up on prices may be a source of specification error (Anderson and Van Wincoop, 2004).

A third issue that needs further research is the relevance and implications of incomplete specialization for the gravity-model analysis of bilateral trade, especially at a disaggregate level. The prevalence of zero-flows at more disaggregate levels of trade may be related to incomplete specialization in homogeneous goods. Evenett and Keller (2002) argue that the gravity model can also hold under incomplete specialization, but this may be the result of their focus on a two-country model (see Feenstra, 2004). Alternatively, in a world of incomplete specialization at the disaggregate level, gravity may still hold at the aggregate level, but not at a sufficiently disaggregated level (Eaton and Kortum, 2002). Recent evidence by Debaere (2002) shows that gravity may not work well to describe trade between less-developed countries after all, which may reflect that these countries tend to specialize in the same basic agricultural goods or similar low-skill intermediates (Feenstra, 2004). This disputes earlier findings by Hummels and Levinsohn (1995), who used a similar gravity model to show that it worked just as well for developed and developing country trade. These papers, though, focus on *frictionless* gravity models, variations on equation (4.5) in this thesis. This may not be the most relevant model to describe actual trade patterns (Grossman, 1998). Still, the issues involved warrant further research. Dealing with zero-flows should be one of the topics of interest for that research, both from a theoretical point of view and in terms of the econometric approach to be chosen.

Arriving at the end of this thesis, let us remark that some methodological considerations are in need of further exploration. In the fundamentals of the gravity model under incomplete specialization, country-specific price levels are relevant. Because good data on price levels are largely absent, country-specific fixed-effects regression provides the best approach to take the effects of country-specific effects into account. However, this implies that all country-specific variables drop out of the gravity equation in cross-sectional applications. In our case, the most important consequence was that the institutional quality variable drops out of the equation. Panel-data estimation provides little avail, because most variation in institutions occurs in the cross-sectional dimension. We only have data on institutional quality in a few years, and the variation observed over time is very small and may reflect mostly measurement error (Kaufmann et al., 2003). Therefore, an approach suggested by Egger (2005) may be worthwhile to develop further. He suggests a fixed-effects cross-section estimator, in which the effect of country-specific variables can still be estimated, using a variant of instrumental variables estimation (the two-way Hausman-Taylor approach). The search now should be to find a proper instrument for institutional quality. Perhaps, geographical or cultural variables provide an outcome. The fixed-effects method could also be useful to tackle potential long-term endogeneity between trade and institutional quality, as suggested by the earlier discussion in this conclusion and in Chapter 2, on the interrelations between geography, culture and institutions.

Finally, returning to the surprising effect of cultural distance, we noted that an approach focusing on total bilateral sales would give a more comprehensive picture of the effects of intangible barriers to international exchange. This implies that the trade-off between export and FDI sales should be further explored, acknowledging that (intangible) barriers not only affect the costs of export, but affect the costs of FDI as well. Egger and Pfaffermayr (2004) have developed a model of export and horizontal FDI based on this approach, to analyse the effect of physical distance on bilateral export and FDI. Another recent reference is De Groot et al. (2005), who empirically analyse the effect of institutions and cultural distance on total bilateral transactions and the mixture of FDI sales and exports.

Data Appendix

This appendix contains two sections. Section 1 describes the data used in Part II of the thesis and their sources. Section 2 consists of a table that lists all the countries and that indicates for each chapter separately which countries have been included in the analysis. Section 3 consists of a table that presents descriptive statistics for the regression samples used in Chapters 4–6.

1.1 Data used for the estimation of gravity equations

The empirical analysis in this thesis uses both country-specific and bilateral data from various sources. The GDPs of the exporting and importing countries are examples of country-specific variables, while geographic distance, adjacency, and common language and religion, among others, are examples of bilateral characteristics for each pair of countries. Below we have described the data and sources in more detail. The analysis in Chapters 4 and 6 applies to 1999. For Chapter 5, the analysis is based on 1998. Moreover, Chapter 5 involves additional data on disaggregate trade. Section 1.2 describes the classification according to product type used in Chapter 5.

Trade

- The dependent variable in the gravity equations is the log of the value of bilateral merchandise exports, which results in two observations for each country pair, i.e. the export flows from country *i* to *j*, and those from *j* to *i*. We have used the UN COMTRADE database for bilateral trade flows that refer to 1999 for Chapters 4 and 6, and to 1998 for Chapter 5. We have used reported imports rather than reported exports, because import data provide a better coverage. We have used mirror import flows between *i* and *j*; the direction of these mirror import flows corresponds to that of the export flows from *i* to *j*. Although mirror import data have fewer missing trade observations than export data, some trade flow observations are reported missing in mirror imports whereas corresponding exports are non-zero. We have confronted missing observations in reported mirror imports with corresponding flows in reported exports; when corresponding reported exports were non-zero, these values have been substituted in reported mirror imports. Thus, only trade flows that are missing in both reported mirror imports and reported exports have been treated as zero-entried trade values (or non-availables, in regressions that omit zero flows).

GDP and GDP per capita

- The source of GDP and GDP per capita data is the World Development Indicators (World Bank, 2000 - on CD Rom). Both are in constant US $ at 1995 prices and refer to 1999 for Chapters 4 and 6, and to 1998 for Chapter 5.

Bilateral characteristics: distance, adjacency, trade area, language, colonial history and religion

- The data on geographic distance, common border, common official language, common regional trade agreement, common dominant religion and common colonial history have been collected from diverse sources, which have kindly been made available by several researchers and research institutes on the internet. We have used OECD data for regional integration agreements, Sala-i-Martin's (1997)[1] database for religions and colonial backgrounds, and Jon Haveman's International Trade Data[2] for distance, contiguity and language. This part of the database is available upon request. Some remarks on these variables are:
  - Distance is measured as straight line distance ('as the crow flies') between nation capitals. The data are from the data website of Jon Haveman. In line with previous research, geographic distance is measured as the distance from home to foreign 'as the bird flies', using the principal city of each country as its centre of gravity. This implies that the distance between the two centres of gravity of neighboring countries is likely to overestimate the average distance of trade between them. The relative impact of mismeasurement is much larger in neighboring countries than in countries that are located far away from each other. For a discussion on the use and usefulness of other, more sophisticated measures of geographic distance, we refer to Frankel (1997, chapter 4). In general, more sophisticated geographic distance measures produce similar results, and cannot eliminate the measurement error for contiguous countries either.
  - The border dummy takes the value of one if two countries are adjacent. Adjacency requires either a land border or a small body of water as border. Measurement error in the distance variable, as well as the effect of historical relations between adjacent countries are captured by this dummy variable. The contiguity data are from the website of Jon Haveman.
  - Whether pairs of countries take part in a common regional integration agreement (RIA) has been determined on the basis of OECD data on major regional integration agreements.[3] A dummy variable indicates whether a pair of countries enters into at least one common RIA.
  - To assess whether two countries have the same official language, we use a database collected by Jon Haveman, that distinguishes fourteen languages: Arabic, Burmese, Chinese, Dutch, English, French, German, Greek, Korean, Malay, Persian, Portuguese, Spanish and Swedish. This data has been extended to cover more countries and languages with CIA's World Factbook[4]. In case none of the above applied and no further language data were available, countries were assigned to the categories 'other language' or 'non available'. A language dummy variable reflects whether or not two countries have a common language.
  - Cultural and/or historical ties between countries may also consist of a shared colonial past or a common dominant religion. Data for these variables come from Sala-i-Martin

[1] See: http://www.columbia.edu/~xs23/data.htm.
[2] See: http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradedata.html.
[3] See: http://www.oecd.org/dataoecd/39/37/1923431.pdf
[4] See: http://www.cia.gov/cia/publications/factbook/.

(1997).The colonial dummy variable reflects whether country pairs share a colonial history. The data consider the British, French and Spanish empires only. In contrast to the original data source, we also included these colonizers themselves into the respective empires. In this way, the figures identify shared colonial relations for pairs of countries.
  - Based on the percentage of the population adhering to one of seven major religions (i.e., Buddhism, Catholicism, Confucianism, Hinduism, Jewish religion, Islam, and Protestantism), country pairs score a value of one on the religion dummy if their dominant religion is the same. For some countries, two religions were equally dominant over the others. In these cases, both religions were considered to be dominant.

Geographical variables

- Several geographical variables have been included as well:
  - The data on islands have kindly been made available by Hildegunn Kyvik Nordas (from Jansen and Kyvik Nordas, 2004). A dummy variable takes the value one if the exporting country is an island. A second dummy indicates whether or not the importing country is an island.
  - The data on landlocked countries and land areas have been collected from the CEPII gravity database.[5] A separate dummy for landlocked countries is included on the export and import side. Land area is measured in square kilometers.

1.2 Classification of disaggregate trade according to product type used in Chapter 5

This section describes in more detail how we have constructed the data set on disaggregated bilateral trade for Chapter 5.

Product-type classification

- The product-type classification developed by Rauch (1999) categorizes 5-digit SITC sectors according to three product types: organized-exchange goods, reference-priced goods, and differentiated goods. The results have been aggregated into a classification at 3- and 4-digit SITC levels, which can more easily be confronted with bilateral trade data. These aggregated classifications have been taken from Jon Haveman's data resources website.[6] Rauch (1999) distinguishes two classification schedules, which differ somewhat in aggregating process: a 'conservative' classification and a 'liberal' classification. The difference arises because the original product-type classification holds at the 5-digit SITC level. An aggregation to the 4-digit level introduces some ambiguity when several 5-digit items within a 4-digit sub group have been classified as different product types. We have used the conservative classification of products. This classification is reluctant to classify 3- and 4-digit SITC sectors as homogeneous. The liberal classification more easily classifies sectors as homogeneous.

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[5] See: http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

[6] See: http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html#Rauch.

Trade per product group

- Trade values per product group were constructed from COMTRADE data using the World Bank WITS interface. Product groups were defined following the classification according to Rauch at the 3- and 4 digit level of SITC Rev.2. To construct each product group, constituent 3-digit groups and 4-digit sub-groups were selected. When both 3-digit and 4-digit classification-scores were listed and information at both levels contradicted, we have only used the 3-digit classification to extract trade flows, for as far as they were not further classified at the 4-digit level. All 4-digit information available in the classification has explicitly been used to classify and extract trade values per product group, for trade values that had been reported at the 4-digit level too.

2 List of countries: characterization of the samples used in the various chapters

Country	Abbreviation	Chapter 1 and 4	Chapter 5	Chapter 6
Albania	ALB	x	x	x
Algeria	DZA	x	x	
Argentina	ARG	x	x	x
Armenia	ARM	x		x
Australia	AUS	x	x	x
Austria	AUT	x	x	x
Azerbaijan	AZE	x	x	x
Bahamas, The	BHS	x		
Bangladesh	BGD		x	
Belarus	BLR	x	x	
Belgium	BEL	x		x
Belize	BLZ	x	x	
Benin	BEN	x	x	
Bhutan	BTN	x	x	x
Bolivia	BOL	x	x	
Brazil	BRA	x	x	x
Brunei	BRN		x	
Bulgaria	BGR	x	x	x
Burkina Faso	BFA	x	x	x
Burundi	BDI	x	x	
Cameroon	CMR	x	x	
Canada	CAN	x	x	x
Chile	CHL	x	x	x
China	CHN	x	x	x
Colombia	COL	x	x	x
Costa Rica	CRI	x	x	x
Cote d'Ivoire	CIV	x	x	
Croatia	HRV	x	x	x
Cyprus	CYP	x	x	
Czech Republic	CZE	x	x	x
Denmark	DNK	x	x	x
Dominican Rep.	DOM	x	x	x
Ecuador	ECU	x	x	x
Egypt, Arab Rep.	EGY	x	x	x
El Salvador	SLV	x	x	x
Estonia	EST	x	x	x
Ethiopia	ETH	x	x	x
Finland	FIN	x	x	x
France	FRA	x	x	x
Gabon	GAB	x		
Gambia	GMB	x	x	
Georgia	GEO	x	x	x
Germany	DEU	x	x	x
Ghana	GHA	x	x	x

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Greece	GRC	x	x	x
Guatemala	GTM	x	x	x
Guinea	GIN	x	x	
Guyana	GUY	x	x	
Honduras	HND	x	x	
Hong Kong, China	HKG	x	x	x
Hungary	HUN	x	x	x
Iceland	ISL	x	x	
India	IND	x	x	x
Indonesia	IDN	x	x	x
Iran, Islamic Rep.	IRN	x	x	x
Ireland	IRL	x	x	x
Israel	ISR	x	x	x
Italy	ITA	x	x	x
Jamaica	JAM	x	x	x
Japan	JPN	x	x	x
Jordan	JOR	x	x	x
Kazakhstan	KAZ	x	x	
Kenya	KEN	x	x	x
Korea, South (Rep.)	KOR	x	x	x
Kuwait	KWT	x		x
Kyrgyzstan	KGZ	x	x	
Latvia	LVA	x	x	x
Lebanon	LBN	x	x	x
Lithuania	LTU	x	x	x
Luxembourg	LUX	x		x
Macedonia, FYR	MKD	x	x	
Madagascar	MDG	x	x	
Malawi	MWI	x	x	x
Malaysia	MYS	x	x	x
Mali	MLI	x	x	
Malta	MLT	x		x
Mauritius	MUS	x	x	
Mexico	MEX	x	x	x
Moldova	MDA	x	x	
Mongolia	MNG	x	x	
Morocco	MAR	x	x	x
Nepal	NPL	x	x	x
Netherlands	NLD	x	x	x
New Zealand	NZL	x	x	x
Nicaragua	NIC	x	x	
Niger	NER	x	x	
Nigeria	NGA	x	x	x
Norway	NOR	x	x	x
Pakistan	PAK	x	x	x

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Panama	PAN	x	x	x
Papua New Guinea	PNG		x	
Paraguay	PRY	x	x	
Peru	PER	x	x	x
Philippines	PHL	x	x	x
Poland	POL	x	x	x
Portugal	PRT	x	x	x
Romania	ROM	x	x	x
Russian Federation	RUS	x	x	x
Rwanda	RWA	x	x	
Saudi Arabia	SAU	x	x	x
Senegal	SEN	x	x	
Singapore	SGP	x	x	x
Slovak Republic	SVK	x	x	x
Slovenia	SVN	x	x	x
South Africa	ZAF	x	x	x
Spain	ESP	x	x	x
Sri Lanka	LKA	x		x
Sudan	SDN	x	x	
Suriname	SUR	x		x
Sweden	SWE	x	x	x
Switzerland	CHE	x	x	x
Syrian Arab Republic	SYR	x	x	x
Tanzania	TZA	x	x	x
Thailand	THA	x	x	x
Togo	TGO	x	x	
Trinidad & Tobago	TTO	x	x	x
Tunisia	TUN	x	x	
Turkey	TUR	x	x	x
Turkmenistan	TKM	x	x	
Uganda	UGA	x	x	
Ukraine	UKR	x	x	x
United Kingdom	GBR	x	x	x
United States	USA	x	x	x
Uruguay	URY	x	x	x
Venezuela	VEN	x	x	x
Vietnam	VNM	x	x	x
Yemen, Rep.	YEM	x	x	x
Yugoslavia	YUG	x		x
Zambia	ZMB	x	x	x
Zimbabwe	ZWE	x		
Sample size		127	119	92

Note: Exclusion of a country in the sample used in chapters 1 and 4 is due to lack of data on GDP or trade for 1999. Exclusion in the sample used in chapter 5 is due to lack of data on trade or GDP for 1998. An additional reason for exclusion of countries in the sample used in chapter 6 is lack of data on culture.

3 Descriptive statistics for the regression samples used in the chapters of Part II

	Chapter 4				Chapter 5				Chapter 6			
	Mean	SD	Min	Max	Mean	SD	MIn	Max	Mean	SD	MIn	Max
Log Trade:												
– aggregate trade	7.81	3.92	–6.91	19.11	10.56	2.54	–1.89	19.00	9.13	3.71	–5.30	19.11
– organized exchange					6.32	3.76	–6.91	16.51				
– organized exch. (excl.petroleum)					6.14	3.65	–6.91	16.01				
– reference price					7.85	3.23	–6.91	17.21				
– differentiated					9.07	3.02	–6.21	18.40				
Log GDP exporter	24.26	2.06	19.81	29.79	25.35	1.94	19.81	29.79	24.78	1.96	19.81	29.79
Log GDP importer	24.22	2.08	19.81	29.79	24.82	2.13	19.81	29.79	24.76	1.97	19.81	29.79
Log Distance	8.58	0.86	4.43	10.53	8.43	0.97	4.43	9.98	8.57	0.91	4.70	9.90
Log GDP/cap exp.	7.95	1.61	4.72	10.87	8.46	1.58	4.72	10.73	8.21	1.59	4.72	10.87
Log GDP/cap imp.	7.92	1.62	4.72	10.87	8.16	1.63	4.72	10.73	8.20	1.59	4.72	10.87
Border Dummy	0.02	0.16	0.00	1.00	0.05	0.21	0.00	1.00	0.03	0.16	0.00	1.00
Trade area Dummy	0.07	0.25	0.00	1.00	0.12	0.33	0.00	1.00	0.08	0.28	0.00	1.00
Language Dummy	0.08	0.27	0.00	1.00	0.10	0.30	0.00	1.00	0.07	0.26	0.00	1.00
Colonial Dummy	0.11	0.32	0.00	1.00	0.13	0.34	0.00	1.00	0.10	0.31	0.00	1.00
Religion Dummy	0.20	0.40	0.00	1.00	0.23	0.42	0.00	1.00	0.20	0.40	0.00	1.00
Inst. quality exporter	0.27	0.88	–1.45	1.98	0.54	0.90	–1.45	1.98	0.41	0.87	–1.24	1.98
Inst. quality importer	0.25	0.88	–1.45	1.98	0.39	0.90	–1.45	1.98	0.41	0.86	–1.24	1.98
Institutional distance	2.15	2.23	0.01	13.36	2.28	2.26	0.01	13.25	2.11	2.11	0.01	12.44
Cultural distance									2.12	1.62	0.00	12.20
Number of observations	13682				6336				7819			

Note: The descriptive statistics are based on the regression samples in the respective chapters. Note that in the regression sample, not all exporting countries also appear as importing country, and vice versa, because zero flows have not been included in these samples. For Chapter 5, the balanced non-zero sample was applied. Descriptive statistics for the full symmetric matrices of country pairs for each chapter are available on request.

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Samenvatting (Summary in Dutch)

Subjectieve Handelsbarrières
Het Effect van Instituties, Cultuur en Afstand op Handelspatronen

Introductie

De voordelen van internationale handel zijn groot, aangezien tussen landen aanzienlijke verschillen bestaan in technologische kennis en de beschikbaarheid van productiefactoren. Bovendien biedt internationale handel aan consumenten een ruimere keuze aan producten en geeft het producenten de mogelijkheid om tegen lagere kosten te produceren, vanwege de schaalvoordelen die kunnen worden benut door een wereldwijde afzetmarkt. Dankzij de technologische vooruitgang in transport en communicatie en de omvangrijke liberalisering van de internationale handel, heeft de wereldhandel een snelle groei doorgemaakt in de tweede helft van de twintigste eeuw. In het huidige tijdperk van mondialisering lijkt deze trend van internationale economische integratie zich versterkt door te zetten. Tegen de achtergrond van de potentiële baten van handel en de snelle groei van de wereldhandel tijdens de laatste decennia, blijft internationale handel toch verrassend beperkt, wanneer deze vergeleken wordt met de totale omvang van de wereldeconomie. Dit wijst op het bestaan van hardnekkige en omvangrijke barrières, die handel belemmeren door de kosten ervan op te drijven.

Dit proefschrift is erop gericht een bijdrage te leveren aan het begrijpen van de onderliggende determinanten van de omvang en variatie in internationale handelsstromen. De waargenomen handelspatronen geven het belang aan van de economische afstand tussen landen. Economische afstand wordt gewoonlijk geassocieerd met de fysieke afstand tussen landen, die transportkosten met zich mee brengt, en met importtarieven en andere handelsbeperkingen. De traditionele, objectieve handelsbarrières, zoals transportkosten en handelsbeperkingen, lijken echter onvoldoende te verklaren waarom internationale handel nog steeds relatief beperkt blijft. Grotendeels verborgen handelskosten zijn ook belangrijk om handelspatronen te helpen verklaren. Deze komen voort uit subjectieve handelsbarrières die veroorzaakt worden door culturele en institutionele verschillen tussen landen. De doelstelling van dit proefschrift is om de onderliggende relaties tussen subjectieve handelsbarrières en handelspatronen bloot te leggen en het belang van deze barrières voor handelsstromen te onderzoeken.

Het proefschrift bestaat uit zeven hoofdstukken, die (na het eerste introducerende hoofdstuk) verspreid zijn over drie delen. In Deel I behandelt Hoofdstuk 2 de theoretische achtergrond voor het onderzoek naar het effect van subjectieve handelsbelemmeringen. Hoofdstuk 3 voert een kwantitatief literatuuronderzoek uit naar de omvang en ontwikkeling over de tijd van het fysieke afstandseffect op handel. De Hoofdstukken 4 tot en met 6 vormen samen Deel II van het proefschrift en voeren empirisch onderzoek uit naar de effecten van institutionele en culturele barrières op bilaterale handel. Daarbij richt Hoofdstuk 5 zich bovendien op de vraag of het effect van dergelijke barrières op sectorniveau afhangt van marktomstandigheden, in het bijzonder de mate van productdifferentiatie. Deel III (Hoofdstuk 7) brengt de onderzoeksresultaten samen en gaat in op de beleidsrelevantie van de bevindingen. Omdat er altijd vragen blijven liggen en nieuwe vragen opkomen, geeft het laatste hoofdstuk ook nog enkele suggesties voor verder onderzoek.

Samenvatting van de onderzoeksbevindingen

In Hoofdstuk 1 introduceren we de belangrijkste handelsbarrières waar in het proefschrift dieper op wordt ingegaan. Het effect van fysieke afstand tussen landen dient als illustratie voor het belang van zowel objectieve transportkosten als subjectieve handelsbelemmeringen, die samenhangen met onvolledige informatie en de mate van culturele vertrouwdheid tussen landen. Het proefschrift onderzoekt twee vormen van subjectieve barrières in het bijzonder. Het betreft institutionele handelsbelemmeringen die gerelateerd zijn aan de veiligstelling van eigendomsrechten en contractuele afspraken in internationale transacties, en culturele barrières die voortkomen uit internationale verschillen in onderliggende waarden en normen. Hoofdstuk 2 geeft een verdere toelichting op deze factoren. De achterliggende motivatie voor het belang van dergelijke subjectieve handelsbelemmeringen is dat het relatief lastig is om succesvolle samenwerking te realiseren en te waarborgen over landsgrenzen heen. Verscheidene dimensies van dit ‘fundamentele handelsprobleem’ kunnen worden onderscheiden. Een wezenlijk kenmerk van internationale handel is het overschrijden van internationale grenzen, en daarmee van verschillende jurisdicties. Daarmee is de veiligstelling van eigendomsrechten en de afdwingbaarheid van contracten minder gegarandeerd. Indien bilaterale handel in beide landen ondersteund wordt door transparante, onafhankelijke regulering vanuit de overheid en een effectieve rechtshandhaving, zullen de transactiekosten die samenhangen met internationale handel binnen de perken kunnen worden gehouden. Dit onderstreept de relevantie van een effectief raamwerk van formele instituties (wet- en regelgeving) in beide landen voor de mate van bilaterale handel. Naast het kwaliteitsniveau van instituties, is ook de mate van overeenkomst in institutionele effectiviteit tussen landen van belang. Wanneer handelaren van huis uit gewend zijn aan de kwaliteit van institutionele ondersteuning in een ander land, zijn ze beter in staat te opereren binnen de daar vigerende institutionele randvoorwaarden. Dit leidt tot lagere transactiekosten en vergroot het vertrouwen in succesvolle samenwerking. Met het voornoemde vertrouwen is een tweede belangrijk element van het fundamentele handelsprobleem aangestipt. Een gebrek aan bilateraal vertrouwen overschaduwt vaak de potentiële voordelen van handel drijven. Deels is de mate van vertrouwen gebaseerd op de verwachte objectieve netto baten voor handelspartners van coöperatief en non-coöperatief gedrag. Dit formele vertrouwen is voor een belangrijk deel gerelateerd aan de kwaliteit van formele institutionele waarborgen, zoals het justitiële systeem. Daarnaast is vertrouwen ook deels gebaseerd op culturele verschillen tussen landen. Als een ander land relatief onbekend is of verschilt in culturele waarden en normen, ontbreekt vaak rechtstreekse persoonlijke communicatie, wederzijds begrip en goedkeuring van de wijze van zaken doen. Dit leidt tot minder formeel en informeel vertrouwen, waardoor verschillen in culturele waarden en institutionele omgeving leiden tot lagere netto opbrengsten van internationale handel. Informatie over en kennis van buitenlandse markten is meestal beperkt. Internationale handel brengt daarom aanzienlijke zoekkosten en aanpassingskosten met zich mee. Naast onbekendheid met buitenlandse culturen, vormen verschillen in culturele waarden en normen een verdere aanleiding voor hoge bilaterale interactiekosten. Culturele verschillen leiden immers tot verschillen in managementpraktijken en organisatie tussen landen. Het vermogen om effectief samen te werken is geringer, wat tot een stijging van transactiekosten leidt.

Het proefschrift voert empirisch onderzoek uit naar het belang van de institutionele en culturele barrières die ten grondslag liggen aan deze transactiekosten en de mate van vertrouwen, voor het verklaren van internationale handelsstromen. Dit onderzoek maakt gebruik van het gangbare empirische model voor de beschrijving van handelspatronen, het zogenaamde graviteitsmodel. Het model, dat zijn naam ontleent aan de graviteitsvergelijking van Newton, verklaart bilaterale handel als een functie van de economische 'massa' (productie- en marktomvang) van handeldrijvende landen en de economische afstand (handelsbarrières) tussen de landen. Hoofdstuk 2 bespreekt de theoretische onderbouwing van het graviteitsmodel en geeft aan hoe (subjectieve) handelsbelemmeringen in het model kunnen worden opgenomen en onderzocht.

Geografische afstand wordt standaard gebruikt in het graviteitsmodel als benadering voor handelsbelemmeringen tussen landen. Fysieke afstand leidt zowel tot objectieve barrières, in de vorm van transportkosten, als tot subjectieve barrières zoals culturele onbekendheid en onvolledige informatie. Empirische bevindingen van eerdere studies tonen gewoonlijk aan dat geografische afstand een substantieel effect heeft op de intensiteit van bilaterale handel. Hoofdstuk 3 analyseert de bevindingen over het fysieke afstandseffect op handel door middel van meta-analyse. Meta-analyse levert een methodologische bijdrage aan het debat over de omvang van het afstandseffect in handelspatronen. Bestaande empirische schattingen van een specifiek effect kunnen worden gecombineerd om kwantitatieve uitspraken te doen over de determinanten van variatie tussen de individuele schattingen. De meta-analyse bevestigt het belang van fysieke afstand voor handel; de afstandselasticiteit van handel ligt gemiddeld op ongeveer 0.8 (positief gedefinieerd). Een stijging van afstand met 1% leidt aldus gemiddeld tot een daling van handel met 0.8%. De individuele schattingen in de literatuur variëren echter substantieel. Meta-regressie analyse toont aan dat een groot deel van deze variatie verklaard kan worden door verschillen in schattingsmethoden en specificatiekenmerken tussen de primaire studies. Bovendien wijst meta-regressie statistisch significant uit dat het afstandseffect over de tijd is toegenomen. Over de vorige eeuw als geheel is het effect gestegen met een geschatte 0.2 procentpunt, een stijging met 30% ten opzichte van het begin van de eeuw. Bezien vanuit de voortdurende verbetering in transportfaciliteiten en communicatiemogelijkheden, ondersteunt dit de stelling dat subjectieve handelsbelemmeringen voor een belangrijk deel bijdragen aan het effect van afstand op handel.

Nadat Deel I van het proefschrift de achtergrond heeft geboden voor het belang van subjectieve handelsbarrières, onderzoekt Deel II (Hoofdstukken 4 tot en met 6) het effect van institutionele en culturele handelsbelemmeringen op handelsstromen empirisch met behulp van het graviteitsmodel. Hoofdstuk 4 behandelt het verband tussen handel en variatie in de kwaliteit van formele instituties. Zoals betoogd in Hoofdstuk 2 zijn effectieve instituties, zoals een onafhankelijk justitieel systeem en een transparante en onpartijdige overheid, van belang voor het zekerstellen van eigendomsrechten en het handhaven van contracten in internationale handel. Bovendien leidt een groot verschil in de institutionele omgeving tussen landen tot additionele transactiekosten, vanwege de wederzijdse onbekendheid met de gewenste formele en informele procedures bij handelstransacties. Daarom maakt de analyse onderscheid tussen het effect van institutionele kwaliteit en institutionele afstand, aan de hand van subjectieve indicatoren voor de effectiviteit van instituties, zoals de onafhankelijkheid van de rechtspraak, de transparantie van overheidsregulering en de bestrijding van corruptie. De empirische resultaten geven aan dat beide aspecten van de institutionele omgeving belangrijk zijn voor de intensiteit van bilaterale handel. Als de institutionele kwaliteit in het exporterende land één standaardafwijking boven het gemiddelde niveau ligt, leidt dit tot 50% meer export; voor het importerende land leidt een dergelijke mate van bovengemiddelde institutionele kwaliteit tot gemiddeld 37% meer import. Het effect van institutionele afstand op handel, gemeten volgens een aantal alternatieve methoden, is ook substantieel. Zo leidt een verschil in institutionele kwaliteit groter dan twee maal de standaardafwijking van institutionele kwaliteit in de steekproef, gemiddeld tot 27% minder bilaterale handel ten opzichte van landenparen waarvan de institutionele afstand lager dan twee standaardafwijkingen is. Bij gebruik van een graduele indicator voor institutionele afstand, in plaats van het onderscheiden van twee categorieën, wijzen de resultaten uit dat een stijging van institutionele afstand met één standaardafwijking leidt tot een geschatte daling in bilaterale handel met 12%. Deze bevindingen duiden op een substantiële bijdrage van variatie in institutionele kwaliteit voor het verklaren van subjectieve handelsbarrières. De resultaten zijn robuust voor het effect van andere aspecten van economische afstand die gecorreleerd zouden kunnen zijn met institutionele kwaliteit of institutionele afstand, zoals bilaterale importtarieven en verschillen in preferenties.

In Hoofdstuk 5 zoeken we uit of het handelseffect van institutionele barrières op sectorniveau verschilt naar productsoort. Hoofdstuk 2 heeft opgemerkt dat de verbanden tussen subjectieve handelsbelemmeringen en handelsstromen deels overlappen. De effecten van onvolledige informatie en institutionele barrières vertonen samenhang, bijvoorbeeld. Om het effect van dergelijke interactie te onderzoeken, analyseert Hoofdstuk 5 de handelspatronen in drie productgroepen. We onderscheiden twee soorten homogene producten, namelijk goederen die verkocht worden op gecentraliseerde markten en goederen waarvoor referentieprijzen worden gepubliceerd. Deze producten zijn onderling volledig vergelijkbaar op basis van prijsverschillen. De derde en laatste productsoort bestaat uit gedifferentieerde producten. Deze producten zijn niet volledig vergelijkbaar op basis van prijzen; ze kunnen verschillen in tal van andere relevante productdimensies, zoals kwaliteit, vorm, omvang, materiaal, enzovoorts. Hoofdstuk 5 onderzoekt of institutionele kwaliteit en institutionele afstand meer van belang zijn voor handel in gedifferentieerde goederen dan voor homogene goederen. De centrale gedachte hierachter is dat minder effectieve instituties en grotere institutionele afstand een groter effect hebben op de kosten van contractuele zekerheid en andere transactiekosten voor gedifferentieerde goederen. Dit weerspiegelt de noodzaak voor hogere transactiespecifieke investeringen bij handel in gedifferentieerde goederen. Vanwege onvolledige informatie moeten zoekkosten en andere investeringen worden opgebracht voor handel met een buitenlandse markt. Deze kosten zijn hoger voor gedifferentieerde goederen, omdat de productvarianten niet uitsluitend op basis van (gecentraliseerde) prijsinformatie kunnen worden vergeleken. Als gevolg van de hoge verzonken zoekkosten en aanpassingskosten bij gedifferentieerde producten, is het van belang te kunnen investeren in succesvolle en langdurige handelsrelaties. Daarom spelen sociale en zakennetwerken een belangrijke rol om dergelijke kosten te verlagen, en effectief een geschikte handelspartner te kunnen vinden. Omdat de risico's en kosten van opportunistisch gedrag hoger zijn als gevolg van de relatiespecifieke investeringen, zijn netwerken echter niet afdoende om opportunistisch gedrag in te dammen. Om die reden verwachten we dat institutionele barrières een groter effect hebben op handel in gedifferentieerde goederen dan in referentieprijs artikelen, en dat deze barrières relatief het minst van belang zijn voor handel op gecentraliseerde internationale markten.

Omdat de analyse in Hoofdstuk 5 zich richt op een sectoraal aggregatieniveau doet zich het probleem voor dat een relatief groot aantal bilaterale stromen in de handelsdata als ontbrekend wordt aangeduid. Hoofdstuk 5 besteedt daarom expliciet aandacht aan deze zogenaamde nulstromen in de empirische schattingen van graviteitsvergelijkingen. Het standaard graviteitsmodel kan niet omgaan met nulstromen, omdat het model voor ieder landenpaar een positieve handelsstroom voorspelt. Om nulstromen te verklaren vult Hoofdstuk 5 het graviteitsmodel aan met een aparte empirische beschrijving van de economische beslissing om wel of niet tot handel over te gaan. Deze beslissing wordt gebaseerd op de winstgevendheid van individuele handelsrelaties en kan worden verklaard uit de vaste investeringskosten die moeten worden gedragen om tot een buitenlandse markt toe te kunnen treden. Dit leidt tot een sample-selectie model met een standaard graviteitsvergelijking om handel te beschrijven als deze wordt waargenomen en waarin een selectievergelijking het vóórkomen van nulstromen verklaart.

De empirische bevindingen bevestigen dat institutionele kwaliteit het meest van belang is voor handel in gedifferentieerde goederen. Het ontbreekt echter aan ondersteuning voor de stelling dat institutionele afstand ook van meer belang is voor gedifferentieerde goederen. Het is verder interessant dat institutionele factoren ook belangrijk zijn voor het verklaren van nulstromen. Daarbij valt op dat de effectiviteit van instituties in het exportland een vergelijkbaar effect heeft op de winstgevendheid van potentiële handel in alle productgroepen, terwijl de kwaliteit van instituties in het importerende land een groter effect heeft op de selectiebeslissing voor gedifferentieerde goederen. Ook met betrekking tot het effect van instituties op de omvang van handelsstromen op gecentraliseerde markten blijkt dat institutionele kwaliteit aan de importkant van de transactie niet van belang is, in tegenstelling tot instituties in het exporterende land. Dit alles zou erop kunnen wijzen dat het zekerstellen van de aanbod- en transportketen vanuit het exportland een belangrijk element is in het verklaren van het belang van institutionele kwaliteit in het export land. De kosten die met onzekerheid op dit terrein samengaan zijn even relevant voor het tot stand brengen van handelstransacties in homogene goederen als voor handel in gedifferentieerde goederen. Echter, de verzonken kosten voor het zoeken van geschikte handelspartners om een nieuwe importmarkt te betreden lijken meer van belang te zijn voor gedifferentieerde goederen, wat onze hypotheses onderschrijft. De resultaten in Hoofdstuk 5 wijzen er eveneens op dat de meest gebruikte methodes om met nulstromen in bilaterale handel om te gaan, waaronder het vervangen van nullen door een arbitrair klein positief getal en het gebruik maken van 'censored' regressie, niet tot robuuste resultaten leiden en een consistente theoretische onderbouwing ontberen.

Het effect van culturele afstand op handel staat centraal in Hoofdstuk 6. De bestaande literatuur over het effect van cultuur op bilaterale handel richt zich vooral op de effecten van onbekendheid met buitenlandse culturen en markten, die wordt beïnvloed door taalverschillen, koloniale banden en geografische afstand. De mate van bekendheid met buitenlandse culturen behelst echter niet alle mogelijke effecten van cultuur op handel. Naast het wel of niet bekend zijn met een buitenlandse cultuur, speelt ook mee of er culturele verschillen zijn in onderliggende waarden en informele normen. Deze culturele afstand werpt barrières op voor bilaterale interactie. Het bemoeilijkt het vormen van wederzijds vertrouwen en werkt misvattingen in de hand over de manier van werken en met elkaar omgaan, wat leidt tot onvoorspelbaarheid van het gedrag van de handelspartner. Dit alles resulteert in hogere transactiekosten. Hoofdstuk 6 benut indicatoren voor werkgerelateerde culturele waarden en normen, zoals individualistische versus collectivistische waarden en de mate van risicoaversie in de samenleving, om een maatstaf van culturele afstand te definiëren en het effect van culturele afstand op bilaterale handel te schatten. De regressieresultaten wijzen verrassend genoeg uit dat handel toeneemt naarmate culturele afstand groter wordt. Een stijging van culturele afstand met één standaardafwijking binnen de steekproef leidt gemiddeld tot een stijging van 8% in bilaterale handel. Deze bevinding staat in contrast met de hypothese vooraf, die stelt dat culturele afstand zou leiden tot minder handel vanwege hogere transactiekosten. Een mogelijke verklaring voor deze resultaten kan worden gevonden in de literatuur over de relatie tussen internationale handel en directe buitenlandse investeringen (DBI). Een bedrijf kan een buitenlandse markt bedienen door middel van exporten of door lokaal geproduceerde goederen, via een vestiging in de buitenlandse markt die door middel van DBI tot stand is gekomen (zogenaamde DBI-verkopen). De keuze tussen deze verschillende vormen van opereren op de buitenlandse markt wordt onder meer beïnvloed door de verhouding tussen de transactiekosten van handel en de transactiekosten van DBI-verkopen. Hoofdstuk 6 beargumenteert dat een hogere culturele afstand tussen landen leidt tot een stijging van de relatieve kosten van DBI-verkopen ten opzichte van de kosten van exporteren. Culturele afstand veroorzaakt meer risico's en kosten naarmate de intensiteit van de handelsrelatie op de buitenlandse markt hoger is. Omdat de benodigde intensiteit van interactie en de omvang van relatiespecifieke investeringen hoger is voor DBI, zal een grotere culturele afstand tot gevolg hebben dat exporteren relatief aantrekkelijker wordt ten opzichte van DBI. Dit kan resulteren in een substitutie-effect tussen DBI en internationale handel, dat uiteindelijk resulteert in een positief verband tussen culturele afstand en bilaterale export.

In Deel III (Hoofdstuk 7) van het proefschrift wordt stilgestaan bij de onderzoeksbevindingen uit de eerste twee delen. Ten eerste kunnen we de balans opmaken en conclusies trekken met betrekking tot de geformuleerde doelstelling. De empirische analyses in Hoofdstukken 3 tot en met 6 leveren ondersteunend bewijs voor het belang van subjectieve handelsbarrières voor handelspatronen. De meta-analyse in Hoofdstuk 3 wijst uit dat fysieke afstand een substantieel effect heeft op handel. Bovendien volgt uit de meta-regressie analyse dat het effect is toegenomen over de tijd. De gevolgtrekking daaruit is dat uitspraken over de zogenaamde 'death of distance' of de 'emerging borderless world' vooralsnog prematuur lijken te zijn. De kosten van afstand lijken niet gedaald te zijn ten opzichte van de overige productie en transactiekosten. Het lijkt er alleszins op dat de psychologische effecten van fysieke afstand in ieder geval relatief niet verminderd zijn.

De empirische bevindingen in Deel II van het proefschrift ondersteunen het belang van de in Hoofdstuk 2 geopperde institutionele en culturele subjectieve handelsbelemmeringen. De resultaten verduidelijken tevens de werkelijke onderliggende oorzaken voor variatie in internationale handelsstromen. Bijvoorbeeld, Hoofdstuk 4 wijst uit dat de effectiviteit van de institutionele omgeving een verklaring biedt voor de bevinding dat rijke landen relatief meer handel drijven dan kan worden verklaard op basis van de standaard graviteitsvergelijking. Bovendien biedt de analyse in Hoofdstuk 5 meer inzicht in de onderlinge versterking van verschillende subjectieve handelsbarrières op sectorspecifiek niveau. Onvolledige informatie en zoekkosten leiden tot de formatie van internationale handelsnetwerken die zich langs lijnen van culturele bekendheid ontwikkelen. Dit is in het bijzonder van belang bij handel in gedifferentieerde goederen, omdat de internationale 'markt' voor deze goederen minder transparant is. Omdat de hoge zoekkosten en overige relatie-specifieke investeringen voor handel in gedifferentieerde goederen tot hoge kosten en risico's van opportunistisch gedrag leiden, is de kwaliteit van de institutionele randvoorwaarden voor deze goederen dan ook meer van belang dan voor homogene goederen.

Vanuit beleidsperspectief onderstreept het belang van subjectieve barrières voor handelsstromen het nut van investeringen in een transparant en onafhankelijk institutioneel kader van wet- en regelgeving. Immers, effectieve instituties verlagen de kosten die gepaard gaan met internationale handel, en vergroten de mogelijkheden om te profiteren van de in Hoofdstuk 1 genoemde voordelen die gepaard gaan met internationale handel. Naast het directe effect van goede instituties op binnenlandse handel en investeringen, biedt het handelseffect uitzicht op hogere groei en welvaartsstijging door schaalvoordelen in productie, technologische spillovers, dynamische ontwikkeling in specialisatiepatronen en een uitbreiding van de voor consumptie beschikbare productvariëteiten. Een voorbeeld wordt gegeven aan de hand van de Oostwaartse uitbreiding van de Europese Unie (EU). De toetredende landen en toetredingskandidaten hadden al vrijhandelsovereenkomsten met de EU gesloten. De voorwaarden voor toetreding tot de EU stellen echter ook eisen aan de kwaliteit van wet- en regelgeving en de bestrijding van corruptie. Aangezien deze institutionele convergentie tot een daling van de kosten van internationale handel met deze landen zou leiden, zou toetreding tot de EU volgens onze parameterschattingen gepaard kunnen gaan met een stijging in de bilaterale handel met deze landen tussen 19-104%. Instituties zijn door mensen ingesteld en kunnen dus in principe ook door mensen worden verbeterd, mits de juiste prikkels aanwezig zijn voor de benodigde investeringen. Echter, de analyses in dit proefschrift wijzen ook op de hardnekkigheid van institutionele en culturele barrières. Aangezien naast culturele barrières ook geografische barrières, zoals afstand, topologie en klimaat, een blijvende invloed uitoefenen, zijn de uitgangsvoorwaarden wellicht lang niet altijd zodanig dat de baten van institutionele veranderingen de politieke en sociale kosten van het doorbreken van de *status quo* op korte termijn overstijgen. In een dergelijk geval is een externe prikkel, zoals mogelijke toetreding tot de EU of de val van oude machtsstructuren als het communistische Oostblok, noodzakelijk om de transitiekosten van institutionele verandering te verlagen. Als de balans van kosten en baten dan verandert, kan investering in effectieve instituties leiden tot potentiële economische voordelen door een toename van handel, zelfs voor landen die geografisch of cultureel naar binnen gericht zijn.

Het proefschrift besluit met een schets van kwesties die om verder onderzoek vragen. Dit behelst ten eerste een verdere analyse en wellicht uitsplitsing van het fysieke afstandseffect op handel. Daaraan gerelateerd zijn er wellicht mogelijkheden om de ontwikkeling van het afstandseffect en de verdere implicaties van dalende of juist persistente handelsbelemmeringen te bezien vanuit de theoretische en recent meer opkomende empirische ontwikkelingen in de zogenaamde ‘new economic geography’. Verder identificeert Hoofdstuk 7 enkele meer methodologische vragen met betrekking tot de toepassing en specificatie van het graviteitsmodel, en wijst het op de noodzaak tot verder onderzoek naar de relatie tussen handel, DBI en culturele afstand.

The Tinbergen Institute is the Institute for Economic Research, which was founded in 1987 by the Faculties of Economics and Econometrics of the Erasmus Universiteit Rotterdam, Universiteit van Amsterdam and Vrije Universiteit Amsterdam. The Institute is named after the late Professor Jan Tinbergen, Dutch Nobel Prize laureate in economics in 1969. The Tinbergen Institute is located in Amsterdam and Rotterdam. The following books recently appeared in the Tinbergen Institute Research Series:

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